THE SYNAESTHESIA OF A BLIND SUBJECT WITH COMPARATIVE DATA FROM AN ASYNAESTHETIC BLIND SUBJECT.

by: R.H. Wheeler & T.D. Cutsforth.

BF 233
W 567

M.C. MIGEL LIBRARY
AMERICAN PRINTING
HOUSE FOR THE BLIND

Cop. 2

UNIVERSITY OF OREGON PUBLICATION
Vol. 1 JUNE, 1922 No. 10

THE SYNAESTHESIA OF A BLIND SUBJECT WITH COMPARATIVE DATA FROM AN ASYNAESTHETIC BLIND SUBJECT

BY
RAYMOND HOLDER WHEELER, Ph.D.
and
THOMAS D. CUTSFORTH

Application made at the postoffice at Eugene, Oregon, for entrance as second-class matter

BF 233
W65

UNIVERSITY OF OREGON PUBLICATION

The University of Oregon Publication Series is offered in exchange for the publications of learned societies and institutions, universities, and libraries. Address inquiries to MANAGER, UNIVERSITY PRESS, UNIVERSITY OF OREGON, EUGENE, OREGON.

Vol. 1. No. 1. The Efficiency of Oregon Children in the Tool Subjects as Shown by Standard Tests. By Chester Arthur Gregory. pp. 51. Tables. November, 1919 ..... $1.00

No. 2. An Experimental Investigation of the Process of Choosing. By Raymond H. Wheeler. pp. 59. January, 1920. ..... 1.00

No. 3. Earthquakes in Oregon. By Warren Dupre Smith. Reprint. Map. February, 1920 ..... .25

No. 4. The Foster-Child Fantasy. By Edmund S. Conklin. Reprint. March, 1920 ..... .25

No. 5. The Synaesthesia of a Blind Subject. By Raymond H. Wheeler. pp. 61. May, 1920 ..... 1.00

No. 6. Fossil Mollusks from the John Day Basin in Oregon. By G. Dallas Hanna, August, 1920 ..... .50

No. 7. A Study of the Mental, Pedagogical and Physical Development of the Pupils of the Junior Division of the University High School, Eugene, Oregon. By Giles Murrel Ruch, September, 1920 ..... 1.00

No. 8. The Derivation and Standardization of a Series of Diagnostic Tests for the Fundamentals of First Year Algebra. By Harl Roy Douglass, April, 1921. ..... 1.00

No. 9. The Trigoniae from the Pacific Coast of North America. By Earl L. Packard, May, 1921 ..... 1.00

No.10. The Synaesthesia of a Blind Subject with Comparative Data from an Asynaesthetic Blind Subject. By Raymond Holder Wheeler, Ph.D. and Thomas D. Cutsforth, June, 1922 ..... 1.00

UNIVERSITY PRESS PUBLICATION COMMITTEE

Eric W. Allen, Manager University Press, Chairman.

F. G. Young	Alfred Powers	E. L. Packard
H. D. Sheldon	A. R. Sweetser	M. H. Douglass

THE SYNAESTHESIA OF A BLIND SUBJECT WITH COMPARATIVE DATA FROM AN ASYNAESTHETIC BLIND SUBJECT

BY

RAYMOND HOLDER WHEELER, Ph.D.

and

THOMAS D. CUTSFORTH

FOUNDATION FOR THE BLIND
RESEARCH
DEPT.
LIBRARY

PUBLISHED BY THE UNIVERSITY
UNIVERSITY PRESS
EUGENE

TABLE OF CONTENTS

I. General Introduction 3
II. Reagents, Method, Material 7
III. Preliminary Experiments
A. Introduction 9
B. Typical Introspective Data on *A's* Entoptic Phenomenon 9
C. Conclusions Concerning *A's* Entoptic Phenomenon 10
D. The Behavior of *A's* Synaesthetic Visual Imagery Compared with the Behavior of His Entoptic Processes 13
E. Summary of Preliminary Experiments 14
IV. Results from Main Experiments
A. Series 1
a. Visual Imagery
i. Typical Introspective Data 15
ii. Summary of Introspective Data on Visual Imagery 22
iii. Visual Imagery of *A* and *B* Compared 27
iv. The Significance of *A's* Synaesthetic Imagery in Processes of Visualizing 28
b. Auditory Imagery
i. Typical Introspective Data 31
ii. Summary of Introspective Data on Auditory Imagery 34
iii. Auditory Imagery of *A* and *B* Compared 36
iv. Significance of *A's* Synaesthetic Processes in the Field of Auditory Imagery 37
c. Tactual Imagery
i. Typical Introspective Data 38
ii. Summary of Introspective Data on Tactual Imagery 42
iii. Tactual Imagery of *A* and *B* Compared 45
iv. Significance of Synaesthetic Imagery in *A's* Tactual Processes 46
d. Kinaesthetic Imagery
i. Typical Introspective Data 48
ii. Summary of Introspective Data on Kinaesthetic Imagery .. 52
iii. Kinaesthetic Imagery of *A* and *B* Compared 54
B. Series 2. Early and Recent Memories
a. Early Memories
i. Typical Introspective Data 55
ii. Summary of Introspective Data on Early Memories 58
iii. Early Memories of *A* and *B* Compared 61
iv. Significance of Synaesthetic Phenomena in *A's* Early Memories 62
b. Recent Memories
i. Typical Introspective Data 63
ii. Summary of Introspective Data on Recent Memories 66
iii. Our Observers' Recent Memories Compared with Their Earlier Memories 68
iv. Significance of Synaesthetic Phenomena in *A's* Recent Memories 69
C. Series 3. Imagery in Constructive Imagination
i. Typical Introspective Data 72
ii. Summary of Introspective Data on Processes of Imagination 75
iii. Observers *A* and *B* Compared 77
iv. Significance of *A's* Synaesthetic Phenomena in Processes of Imagination 78
D. Series 4. Free Associations
i. Typical Introspective Data 80
ii. Summary of Introspective Data on Free Association 82
iii. Free Association in *A* and *B* Compared 84
iv. Significance of Synaesthetic Phenomena in *A's* Free Associations 85
V. A Theory of Synaesthesia 87
VI. Summary 97
VII. Conclusions 101
Note 103
VIII. Bibliography 104

BF 233
W65
Cop. 2

The Synaesthesia of a Blind Subject with Comparative Data from an Asynaesthetic Blind Subject*

1. General Introduction

In a recent monograph (11) the senior writer reviewed the general subject of synaesthesia and described a very complicated case in a blind reagent. In that investigation it was found that the reagent not only associated a color or a certain degree of brightness with every sensory experience other than the visual but also that these same colored associates invariably appeared in his processes of thinking wherever imagery was employed. The investigation here reported is largely concerned with a description of these analogous associations in certain of the higher intellectual processes.

Out of the vast amount of literature on synaesthesia we find very little mention of the existence of synaesthetic phenomena in connection with mental processes other than that of perceiving. In no instance has a case in the realm of thinking been fully described. In fact we do not know to what extent, in the same individual, synaesthetic phenomena appear both in perceiving and in thinking. So far as our knowledge goes no case has ever been reported in which colored associates or allied associated imagery appeared in thinking but not in perceiving. There seems to be good reason for believing that where such phenomena appear in perceiving, they likewise occur in thinking and that the failure to report this fact, generally, in the literature on synaesthesia has been due to superficial investigations of the phenomena.

A survey of previous studies in this subject reveals the following generalizations:

1. Synaesthesia consists of the appearance of a certain stereotyped image with a given sensory experience. The phenomenon exists in a variety of forms the most common of which is

*The term "asynaesthetic" is used throughout this monograph to mean non-synaesthetic. We are indebted to Professor Edwin G. Boring for suggesting this term and likewise for carefully reading the entire manuscript. To him we wish to express our gratitude for many valuable suggestions and criticisms. We are also indebted in no small degree to Professor Lewis M. Terman who read the manuscript and made many valuable suggestions. To Dr. Harold R. Crosland we wish to express our thanks not only for his kind suggestions but for his generous assistance in reading proof.

the appearance of colored visual images in connection with sounds, tastes, smells and tactual experiences. Where tones appear colored, the experience is called colored hearing. The associated image is sometimes called a photism or chromatism. Usually the associated image is derived from a sense modality other than that of the sensory experience itself. The following is a fairly complete list of the known varieties of synaesthesia:

A. Of acoustic origin
   1. colored hearing of tones, noises, chords, melodies, sounds of vowels, consonants, words and the like;
   2. gustatory audition in which tastes are associated with the sounds of words;
   3. figured audition in which geometrical forms are associated with the sounds of words;
   4. pain audition in which tooth-aches or other pain images are associated with tones of a certain quality.

B. Of visual origin in which visual perceptions of lines, forms, figures, letters, digits and words are accompanied by colors.

C. Of gustatory origin
   1. colored tasting;
   2. colored taste, smell and cutaneous complexes.

D. Of olfactory origin
   1. colored odors.

E. Of cutaneous origin
   1. colored pain, pressure, temperature sensations;
   2. colored tactual and kinaesthetic complexes;
   3. auditory pain in which the sensation of pain is accompanied by imagery of a sound.
   4. Auditory-pressure in which sensations of pressure are associated with imagery of sounds;
   5. cutaneous or kinaesthetic taste in which cutaneous or kinaesthetic sensations are accompanied by images of taste.

E. Of kinaesthetic origin in which kinaesthetic sensations are accompanied by
   1. an image of color or brightness;
   2. an image of taste.

G. Of organic origin in which affective or emotional experiences are accompanied by
   1. an image of color or brightness.

H. Personifications or dramatizations of ideas, letters, digits or words.

This classification represents roughly the order of frequency in which the various forms of synaesthesia are found.

2. Much of the experimental work on synaesthesia has been devoted to the task of ascertaining what factors determine the origin, the variety and the behavior of the associated image. No satisfactory conclusions have been reached concerning the origin of synaesthesis although it is generally believed that the phenomenon is congenital. The modality from which the associated image is derived in any one case was thought to depend

upon certain physiological conditions in the brain; and the quality of the associated image was thought to depend, in many instances, upon laws of association. The behavior of the associated image is undoubtedly determined for the most part by the same factors as control the behavior of the original sensation to which the image becomes attached. That is, the associated image appears at once with the primary sensation; it persists as long as does the primary sensation and disappears when the primary sensation disappears; it fluctuates in intensity or varies in quality as does the primary sensation, and so on.

3. While numerous experimental methods have been employed in former investigations of synaesthesia (11, page 34) in no instance was the reagent a thoroughly trained introspector nor were detailed introspections resorted to in an effort to ascertain the laws of the behavior of the associated imagery.

4. Detailed analyses of large numbers of individual cases have revealed alleged evidence in favor of a physiological explanation of the phenomenon in terms of such processes as irradiation or lack of differentiation of function in cerebral centers. Other evidence, however, pointed to an association theory (11, pages 36-39). A combination of these views is highly unsatisfactory for two reasons: (1) It presupposes two radically different species of synaesthesia—a state of affairs which is unwarranted by the facts; (2) neither view does justice to the functional aspects of synaesthesis itself but merely describes the conditions under which the phenomenon occurs. In other words neither view gives us a clue as to what the *act* of synaesthesis *is*. Only casually has it been mentioned that synaesthesis may be a form of *reflex*.

5. The phenomenon itself is relatively rare, appearing in 8-10 per cent of individuals, according to some investigators. We believe, however, that these figures are too high and that 5 per cent or a number slightly exceeding the frequency of color blindness is more accurate. While in certain individuals synaesthesis appears to be of no particular value, in others it has been found a distinct advantage. From time to time attempts have been made to trace the significance of the phenomenon in the poetry of synaesthetic writers (11, page 26); and certain musicians have endeavored to introduce colors in connection

with musical productions (11, page 60) but owing to the fact that most readers on the one hand and auditors on the other have no synaesthetic phenomena of their own and hence do not understand or appreciate them in other people, such attempts have invariably produced negative results. Should synaesthesis be more common it could not be used in the arts for the reason that the phenomenon varies in content and in complexity from individual to individual. There is no uniformity in the quality or form of the image which happens to become associated with a given sound, letter or object.

6. Whether synaesthesis is a unit trait which follows Mendel's law of inheritance has not been ascertained. There seems to be no definite evidence that the phenomenon is inherited. In some instances it appears to run in families but in a greater number of instances it apparently does not. The early origin of synaesthesis in the life of the individual who possesses it points to the fact that the phenomenon is congenital.

7. Synaesthesis is apparently more common among children than among adults. Probably at least 50 per cent of the total number of cases existing in childhood disappear during the mental changes of the adolescent period. In such instances, however, in which the phenomenon persists over long periods of time and in which the individual has been subjected to repeated tests, the striking fact has been revealed that the associations have remained constant. For example where in early childhood a flute tone appears blue, a flute tone will appear that same quality of blue many years afterward. Of what changes take place in synaesthesis during senescence we have no knowledge.

8. Owing to the fact that the majority of recorded cases of synaesthesia have been perceptual phenomena with only a scattered report now and then of similar associations in processes of thinking there has arisen among psychologists a predisposition to regard true synaesthesia as a peripherally aroused process. Since related phenomena do exist in dreams (12) and in processes of thinking (11, page 39) it is evident that more light may be thrown upon the nature of the perceptual variety from a detailed study of the latter. Moreover, in the latter we find that it is an image of the original sensory experience which now has the same colored associate as did the sensory experience itself.

This leads us to the conclusion that "imaginal synaesthesia" is derived from "perceptual synaesthesia" and therefore has as much claim to the term synaesthesia as its parent phenomenon.

In order to keep these two forms clearly differentiated we shall speak of the perceptual or sensory form, which is peripherally aroused, as "synaesthesia" and shall call the same phenomenon, as it appears in the realm of the higher intellectual processes, a "synaesthetic phenomenon."

We have here introduced as "check data" results from a second *blind* subject who has no synaesthesia of any sort. Thus the data from the synaesthetic subject will be emphasized in contrast with the data from the asynaesthetic reagent.

II. Reagents, Method, Material

The reagents in this investigation were Thomas D. Cutsforth, observer *A* and joint author of this monograph; and Leslie C. Blades, observer *B*. *A* is now 28 years of age. He lost his sight by accident at the age of 11. His right eye was at that time so badly damaged that it was removed and an artificial eye was substituted. Sufficient musculature remained, making it possible for the subject to move the artificial eye slightly in any direction. The left eye became inflamed immediately following the accident, and has remained badly out of focus since that time. The left retina, however, was not destroyed and is still slightly functioning, as our preliminary experiments will reveal. *A* graduated from the University of Oregon in 1918. Since that time he has taught in a high school. At present he is a graduate student and assistant in Psychology at the University of Oregon.

Observer *B* graduated from the University of Oregon in 1916 and obtained an A.M. degree in 1917. He lost his sight by accident at the age of 9. He was 25 years of age when his introspective data were obtained.

The data for this investigation are entirely introspective and were throughout obtained under standardized conditions. *B's* introspections were given during the winter of 1916 while the reagent was a major student in the psychology laboratory, and

were at that time edited by the reagent himself. In introducing this material as data, here, great care has been exercised in keeping them as closely as possible in their original form.

The introspections from observer *A* were obtained during the winter of 1921. Unless otherwise mentioned, the sets of data from both *A* and *B* were obtained under identical conditions and under similar instructions. The senior writer, throughout, was the experimenter.

After the instructions had been given to the observer and the task had been fulfilled, the observer dictated his introspection in as great detail as possible to the experimenter who wrote it down in full. Then, at times, the experimenter asked carefully worded questions in order to obtain greater detail here and there in the introspective descriptions. All such questions, however, were carefully presented in order to avoid any possible influence of suggestion. Rarely were such questions necessary and in no instance was a leading question asked.

Details concerning apparatus and instructions will appear in connection with the presentation of the data. In general the reagent was instructed to assume a comfortable position in his chair and to prepare himself for the instructions. Such a preparation consisted of assuming a receptive attitude toward the instructions and of waiting for any distracting thought or other minor disturbance to pass away before the instructions were finally presented. The reagent then announced when he was ready whereupon the instructions were read to him. In no instance, unless it was particularly desired otherwise, was the reagent warned in advance as to what the nature of the instructions would be. This procedure was followed in order that the resulting mental processes might be as spontaneous as possible and that they might not be affected by antecedent processes. Each series of experiments was separated from the others either by a period of adequate rest or by performance on successive days.

III. Preliminary Experiments

A. Introduction.

Observer *A* is not totally blind. His vision, however, is confined to a certain form of entoptic phenomenon. While on a clear day when the sun is high and the reflection of light from objects in the environment is at a miximum, *A* can obtain vague glimpses now and then of objects near him. Such vision is very uncertain, is always mingled with visual imagery and entoptic phenomena and never exceeds an area larger than the palm of one's hand. Since such experiences are exceedingly rare we need not describe them in detail. That light does at times penetrate to the retina is confirmed by other facts. If *A's* left eye happens to be turned in the proper direction toward a source of artificial light one corner of a vague visual field is at times dimly and momentarily brightened. Owing to the distortion in the shape and direction of the eye-ball such light as does reach the retina always falls upon the periphery and not upon the fovea. *A's* experiences of seeing, as far as external stimuli are concerned, therefore, are confined to blurred and dimmed peripheral vision.

On the other hand *A* is constantly aware of a "field of vision" before him, which is filled with colors and brightnesses of innumerable varieties of quality, size and form. In order to ascertain if possible whether this was synaesthetic imagery or actual visual sensation, *A* gave complete introspective decriptions of these visual experiences.

B. Typical introspective data on A's entoptic phenomenon.

[Note: The numbers which appear before each introspection are introduced for the purpose of reference. In parentheses () are to be found *A's* own interpretations of his introspections, given during the act of introspecting; in brackets [] are to be found the authors' subsequent comments. These comments are intended to bring out the important or highly significant features of the preceding introspective data.]

1. "Outstretched bidimentionally before me at a distance of what appears to be but a few centimeters is a spacial field about as large as one ordinarily sees before him, oval in shape, but with indistinct limits at the periphery. This field is not a flat surface, as if one were looking at a sheet of paper, but resembles, I think, what one would 'see' if he suddenly entered a dark room, so far as depth is concerned. This field is filled with changing colors and brightnesses which are shifting about in kaleidoscopic fashion.

At one instant these colors and brightnesses are irregular blotches which are constantly changing in size, shape and outline. They change so rapidly that it is utterly impossible to describe them in minute detail. The center of this visual field tends to be dominated by yellows, 'pinks,' reds and light greens. The next instant these colors become streaks or 'spatters,' as if they had been sprayed upon some invisible surface, and what corresponds to this surface is a background of changing greys, sometimes real dark, or almost black, and sometimes more of a neutral grey. The background itself is constantly changing in brightness. Farther out from the center of this visual field are darker greens, bluish greens and blues, and still farther, toward the periphery, are dark and very poorly saturated 'bottle' greens or 'navy' blues until, at the very edge, colors and forms alike become indistinct, duller and darker, merging into nothing but shades of black. Again, colors may entirely disappear momentarily and the entire field becomes a mottled grey. At times there appear very suddenly, covering the entire field, fine networks of white or yellowish streaks which resemble flashes of lightning. These flashes whirl about and constantly change their position and direction. Then again I see powdery whirls of fine, grey specks on a darker background, or dark specks on a lighter background, the whole visual field becoming a seething mass of 'molecular-like dust.' There are no reds beyond a limited area in the center of the field; there are no colors in the far periphery. The whole field is characterized by rapidity of change in color and brightness, by sudden and continuous shiftings in the form, shape and outline of the colored areas. All the colors and brightnesses appear the same distance from me and since they are constantly changing in shape and quality hardly ever are there any distinct outlines to these forms. (I believe that they resemble spatterings of of different water colors or shades of black and white as they would appear if painted at random upon a wet surface, upon which the different colors and brightnesses would 'run' together.)"

The following is an account of *A's* remembrance of this phenomenon which extends back to the years 1904 and 1905:

2. " It was in the winter of 1904 that I first noticed this phenomenon and it was during the time that my left eye was recovering from its inflammation. I used to sit by the hour and watch these changing colors and I noticed, at the time, that physical exertion brightened the colors and made them more variable. (This was evidently due to changes in circulation which resulted from physical action.) As I recall the colors as they appeared then, I think that the blotches and irregularly colored areas were at that time larger than they are now and there were larger areas of grey between the colors. Now the forms are smaller and more thickly distributed with resulting smaller areas of grey background."

[Introspection (1) resembles so closely other introspections on this phenomenon that additional data is unnecessary. It is interesting to note that the distribution of colors in this visual field described by *A* corresponds to the distribution of colors in the retinal zones. Reds and greens appear only at or near the center of this visual field; blues and yellows appear toward the periphery and beyond the reds and greens. At the very margin of this visual field there appear only greys and blacks. White streaks may be distributed over the entire field, or at least very close to the margin. This distribution of colors and brightness suggests at once that the phenomenon is sensory, and peripherally aroused.]

C. Conclusions concerning A's entoptic phenomenon.

These introspections describe almost exactly the phenomenon which the normal seeing person can at any time observe when he closes his eyes and presses upon the eye-balls. One often ob-

serves this same phenomenon when he suddenly enters a dark room. It is quite evident, therefore, that *A* has described a form of entoptic phenomenon which is so common that one need not discuss the literature on the subject. The retina possesses a slight amount of "inherent" light of its own, associated perhaps with the "visual purple" or purple pigment which lies adjacent to the rods and cones. It is this faint, inherent light which one "sees" as "black" when he enters an absolutely dark room; and it is because of this inherent light in the retina that under conditions of mechanical stimulation by means of pressure, circulatory changes and the like, one sees colors and varying degrees of brightness, although the eyes are closed or external light is prevented from reaching the retina. This entoptic phenomenon belongs to the class of "muscae volitantes".

The following facts concerning observer *A's* entoptic phenomenon justify us in concluding that he actually sees colors and shades of brightness.

1. The colors and brightness are distributed, in the visual field, according to the distribution of colors in the retinal zones.

2. The phenomenon is continuous in waking life and only by not attending to it can *A* avoid "seeing" it.

3. It is possible to distinguish the behavior and localization of visual imagery from the behavior and localization of the colors and brightnesses of this entoptic phenomenon. Visual imagery may be localized, at will, in front of or behind this entoptic field of vision.

4. The entoptic field of vision is not subject to voluntary control other than as an object of attention. *A* cannot change the forms or colors at will except by employing mechanical means such as pressure upon the eye-ball and under such circumstances the changes are fortuitous so far as voluntary control of the colors themselves is concerned. He cannot cause these colors to appear or disappear except as they tend to become changed by resorting to mechanical means such as pressure upon the eye-ball or eye-movement.

5. The phenomenon has now persisted for 17 years and with the exception mentioned in introspection number 2, it has not changed in the meantime.

6. *A's* retina is subject to constant pressure from within. The shape and position of the eye-ball reveal some evidences of "scar tissue" or other growths which would provide such a presure.

7. Sufficient rays penetrate the eye to keep the retina constantly supplied with inherent light. This conclusion is derived from the fact that when *A's* left eye is in a certain position with reference to a brilliant light, one corner of his peripheral field of vision is dimly and momentarily brightened.

8. *A's* introspections reveal the usual differences between visual sensations and visual imagery:

a. The forms and colors of the entopic phenomena always appear at the same distance from his eye; there is a regularity, constancy and "firmness" or stability about them which visual imagery ordinarily lacks.

b. The forms and colors cannot be projected or localized at will as is characteristic of visual imagery; for example, *A* can project visualized colors or objects behind him but the relative position of this visual entoptic field never changes.

c. *A* can attend to this phenomenon together with visual imagery and is able to note, introspectively, the differences in behavior, quality and localization of the two groups of visual phenomena.

d. If the visual imagery is faint or fleeting entoptic phenomena may claim *A's* attention to the exclusion of the visual imagery; if the latter be vivid or persistent *A* is able to ignore the entoptic field.

e. The greys of the entoptic field function as a background for most of *A's* visual imagery.

9. The fact that *A* actually sees brightnesses and colors accounts for the fact that he is able to describe colors and shades of grey with remarkable accuracy after 17 years of practical blindness; it also explains why visual imagery has retained its vividness and minuteness of detail as far as qualities are concerned. It may also account for the fact that his synaesthetic phenomena, which are invariably visual, have persisted undisturbed by blindness over 17 years of time.

We feel justified, in view of the above facts, in concluding that *A's* visual imagery which functions in his synaesthetic phenomena

is not to be confused with his entoptic phenomenon. The colors and brightnesses in his synaesthetic processes are definitely images and not sensations. They appear and disappear as do ordinary visual images unless their behavior is controlled by the behavior of the primary auditory or tactual sensation of which they are the accompaniments.

D. The behavior of A's synaesthetic visual imagery compared with the behavior of his sensory entoptic processes.

To ascertain whether or not *A's* entoptic phenomenon might exert some influence on the functioning of his visual synaesthetic processes when both appear in consciousness at the same time, a series of tests was made in which the reagent was instructed to attend to the colors of his visual field and to be in readiness to report what happened to this visual field when synaesthetic visual imagery was aroused. This procedure was also undertaken for the purpose of discovering whether *A* ever confused his visual sensations with his synaesthetic visual imagery.

The following introspection is typical and resembles so closely a mass of introspective material on this point that only one is here introduced. While the reagent was attending to the colors and brightnesses of his entoptic field the experimenter placed a piece of cold metal upon his head just to the left of and above his left eye. The reagent did not know in advance what stimulus was to be applied.

3. "I was attending to a particular splotch of poorly saturated red near the center of my field of vision and was non-focally conscious of changing colors and brightnesses over a much wider area when my attention was suddenly claimed by some object touching my forehead and by a widespread muscular response of flinching. This latter reaction was distributed about the shoulders, neck, chest and facial muscles; (I was evidently surprised at being touched on my forehead and was reflexly shrinking from the sudden stimulus.) Up to this time I was totally unaware of what object had been applied and totally unconscious of the fact that the stimulus was cold. After my attention had momentarily lingered upon this widespread motor reaction, I found my line of regard fixated upon the upper left hand section of my field of vision, which suddenly became flooded with white light. I actually detected the light as it came in and occupied for a moment the area of my visual field which had but a moment before been filled with indefinite streaks and spots of faded colors or different shades of grey. Simultaneously with this appearance of a brilliant white light which claimed focal attention, I was dimly aware of the remaining portion of my field of vision and here the kaleidoscopic forms and colors were still persisting. I noted that the brilliant light was slightly nearer my face than the entoptic sensations. I noted also that the colors in the upper left hand section of my visual field vanished or gave way to the white light

as if the light itself had been a cloud-like curtain which had suddenly rolled down in front of the existing colors. I could not see the entoptic colors or forms behind the white light; they had 'melted away'; the white light itself was stable, constant and stationary until the experimenter took away the cold object from my forehead. At no time was I focally aware of the coldness of the metal as such." [The cold metal was applied to *A's* forehead for an interval of three seconds. The nearness of the white silvery light which was associated with the coldness of the stimulus was evidently due to the fact that the area selected for stimulation was adjacent to *A's* left eye. The shape, brilliance and persistence of the synaesthetic image correspond to analogous features of the stimulus. It was found that when auditory stimuli were used the source of which was a meter or more from the reagent, the synaesthetic imagery was invariably localized farther out in space, *i.e.*, beyond the localization of the entoptic colors. But in every instance synaesthetic imagery seemed to flash in or roll into *A's* visual field, at once taking the place of the entoptic sensations, wherever the two tended to occupy the same area.]

Thus it is evident that entoptic phenomena constitute one set of visual experiences and that synaesthetic processes constitute an entirely different group. The first is sensation and the second is image. One can best envisage how *A* is able to ascertain the difference, introspectively, between colored visual imagery and colored entoptic phenomena, by trying to visualize an object or a landscape with his eyes shut, noting at the same time what becomes of the blackness which he "sees" when his eyes are closed. Moreover, it is a matter of everyday experience for the normal sighted person to visualize with his eyes open without confusing visual imagery with visual sensation. We can dispel all doubt, therefore, that the visual imagery which *A* describes in his processes of thinking is not a confused interpretation of his entoptic processes.

E. Summary of preliminary experiments.

a. Observer *A* is not totally blind. With his left eye he "entoptically" sees colors and brightnesses.

b. These colors and brightnesses are sensory experiences and are definitely distinguishable from visual imagery.

c. Our reagent in no way confuses his visual imagery with these entoptic phenomena when the two sets of visual processes are simultaneously present in consciousness.

d. *A's* visual synaesthetic phenomena are visual images and are not to be confused with entoptic processes, although the latter may have played a rôle during his 17 years of blindness, in preventing the former from changing or from decaying.

IV. Results From Main Experiments

A. Series 1.

a. Visual imagery.

i. Typical introspective data.

[Instructions: "Think of a bunch of white rosebuds lying among fern leaves in a florist's box."]

4. *Observer A.* "As soon as the experimenter read the instructions there at once appeared visual imagery of a small bouquet of ivory-white rosebuds about one-third opened, lying in a box, with the tips of the buds pointing to the right. The details of the buds—the shape, the curling of the petals, the qualities of the whiteness, etc.—stood out very distinctly, although outlines were not sharply defined. When the experimenter said 'ferns' I found my attention shifting from this visual imagery of the buds to a region slightly to the left and below them, where I visualized a mass of green, with merely a dark streak or shadow here and there, giving the imagery a 'netted' appearance; I saw no other details of the ferns. I then found myself anticipating the word 'box' in verbal imagery and visualized the front side and one end of a box very distinctly; the box was about three inches in height, but further details of shape and size were fleeting and vague; I saw nothing of the box at its other end, nor did any of it appear through or behind the rosebuds and ferns. At that time I did not build out stems or thorns, nor did I have any tactual or kinaesthetic imagery. The visual imagery appeared in a visual setting. The box of roses was lying on my study table in Friendly Hall but I did not see distinctly any details of the table; beyond the table I saw a dark grey background which tended to differentiate into an open window at the left. There then followed fleeting visual imagery of books but at this juncture I recalled the instructions and began to introspect."

5. *Observer B.* [Same instructions as for observer *A* above.] "As the experimenter read the instructions I was first aware of very fleeting, indefinitely outlined visual imagery of the buds, which were opaque white, not clear but diffuse and 'creamy'; but hardly had this visual imagery appeared when it gave way to tactual imagery of handling soft, spongy buds. I paused and tried to revive the visual imagery again but my efforts were unsuccessful. The buds as I visualized them were lying on something, but what I do not know for there was no visual or other imagery of any object near or beneath this visual imagery; I could obtain no visual imagery of the box nor of the ferns; what might have been a box was a very faint, shadow-like form, somewhat rectangular in shape in that it was longer than it was wide, but the object had no top or no bottom. (This vague, sketchy and fleeting shadow I interpret as a visual image of the box.) The buds lacked detail; I saw in them no outline or superposition of petal. This visual imagery had no setting other than tactual and kinaesthetic imagery which tended at once to claim the focus of my attention; the buds and shadow-like box appeared in a fashion, I presume, as a sighted person might visualize something back of his head in the visual 'nothing' that is there. I then found myself trying to revive this shadow-like visual imagery of the box. I succeeded in obtaining a second shadow, this time slightly brown, which turned to a color darker than that of a brown, but which I cannot label; the surface of this shadow presented a veneered or glossy appearance and was motley as regards light and shade. This shadow soon dwindled to areas which would have been the edges of the box had I touches the object which I was trying to visualize. Then there appeared visual memory imagery of boxes which I had seen as a child, mingled with tactual imagery of running my fingers along the edges and about the corners; together with this mixture of tactual and visual imagery there reappeared fleeting visual imagery of white buds and vague shadow-like forms which represented leaves; here, in connection with this tactual imagery, the visual processes

tended to become more stable and persistent. But very shortly this visual imagery gave way entirely to tactual and kinaesthetic processes. [Tactual and kinaesthetic imagery will be described in detail in a later section of this monograph. It is interesting to note that observer *B* obtains visual imagery with great difficulty and that only when ushered into consciousness or accompanied by tactual and kinaesthetic processes is his visual imagery even approximately stable or persistent. Note also the great contrast between *B's* visual imagery and that of *A*, whose visual imagery of rosebuds was described in introspection 4.]

[Instructions: " Think of some person who is well known to you; try to visualize that person and then dictate your introspection."]

6. *Observer A.* "(I visualized Professor *O.*, whom I have not seen for four years.) First there appeared visual imagery of his forehead and ears as he stood several feet away and facing me; then there appeared fleeting glimpses of his nose and chin. His skin was colored a washed-out yellowish tan (the color of his voice); in this imagery there was no continuity of features between his ears, nose and chin; between these isolated portions of his head was the setting or background of dark grey on which I find myself habitually projecting my visual imagery. After this imagery had appeared and was still lingering in consciousness his mouth 'filled in' between the nose and chin; I then saw that his mouth was opened slightly as if he were speaking; then beneath his chin there appeared portions of his neck, particularly the region which is ordinarily visible above a white collar and in this imagery his 'Adam's apple' stood out prominently. While all of this imagery appeared in rapid succession and with a relatively high degree of clearness it was the general shape and the color of these features which stood out rather than distinctness of outline and detail of shape. The imagery appeared diffuse in those regions which might otherwise form definite lines or edges. (I suppose in this respect my visual imagery resembles the blurred condition of a composite photograph made from exposures of several people on the same plate.) I found it impossible to connect these isolated facial features into one continuous visual image. As this scattered imagery lingered, I then saw teeth showing in the slightly opened mouth; the teeth which stood out the clearest were particularly those lower teeth which would ordinarily but barely show when one is talking. Curiously the lower middle teeth were indistinct; the teeth which became definitized in this visual image were those which lie on either side of the center. My attention was then claimed by fleeting auditory imagery of his voice, accompanied by focal flashes of yellow light—the same color as appeared in my visual imagery of his face and the color which always identifies for me the quality of his voice. This was all of the imagery which I obtained at first and which followed immediately upon my hearing the instructions. This imagery appeared in space at a distance interpreted to be about 14 feet. I then filled out in visual imagery, still in the yellow color of his voice, other parts of his body, including the general shape and outline of his body in a sitting position. Here again I could not see more than a limited portion of him at any one time but as I shifted my line of regard from one part of this vaguely isolated form to another I more definitely pictured his shoulders, then the bottom of his sack coat and from that region I shifted to the bottom of his trousers. With each shift of visual attention I was aware of slight eye movement together with the fact that my fixation point had changed. At no time during the entire process did I have any tactual imagery of touching him nor any kinaesthetic imagery of feeling of his clothes. (The chief features of my visual imagery consisted of their patchy character with areas of a dark grey setting between these patches, and the yellowness of the imagery. I have made the general observation with respect to my visual imagery that I do not tend to shift from visual to tactual or kinaesthetic processes unless the object which I am visualizing is one which I have recently handled in tactual-kinaesthetic fashion.)"

7. *Observer B.* Same instructions. "(I have been trying for several seconds to visualize my old room-mate, but for the most part my efforts have been unsatisfactory.) There first appeared very indistinct and fleeting visual imagery of his forehead, temples and eye-regions, about life-size and colored a vague, dim white. I could not obtain visual imagery of all of these features at one time; I could see no hair, no neck and no ears and I could not distinguish the color of his eyes. In every instance the imagery was photographic and lacking in definiteness of form and outline. The only features which approached definiteness were the facial dimensions of the temples. (I notice that every feature which I have been visualizing is one which I have observed tactually.) Along with the above imagery I had tactual and kinaesthetic images of the smoothness and texture of his skin, and visual imagery now became confused with this tactual and kinaesthetic awareness. For example, my visual images of his nose and chin were confused with tactual-motor images of running my fingers over these facial features. Then upon further effort I was able to conjure up added vague and fleeting visual imagery of a collar and neck-tie, but I am not certain whether this is imagery which ever functioned in connection with memories of my room mate. The collar is white but it is only a mere suggestion of whiteness in the form of a streak localized under a similarly fleeting chin. I saw no color in the tie, for it was merely a shadow-form, broader at the bottom than at the top. None of this visual imagery appeared in a visual setting and while it was localized in space rather close to me the setting was entirely tactual and kinaesthetic."

[Instructions: Visualize some familiar scene or landscape.]

8. *Observer A.* "(I have visualized a certain turn in a country road which I saw in childhood and have not visited since that time.) Looming up before me in space and in what appeared to me to be normal dimensions was a road which extended upward over a very steep grade and through a deep cut. I first saw the flat road at my feet, where the wagon tracks in the sand stood out as the most prominent features; then my attention shifted, visually, to the walls of the cut, which were about shoulder-high; here very little detail stood out, for I saw only the smooth grey walls of sandstone, with here and there a shadow or broken place in the banks, represented by areas or streaks of darker grey. (This I interpreted as meaning the places in the banks where the frost had broken off some of the rock.) I saw no strata nor any details of individual pieces of rock; I saw no details of gravel or of vegetative growth on the sides of these walls. The entire visual image, so far, was a washed grey, but the scene appeared in its proper perspective, *i. e.*, I saw the road becoming smaller and smaller as it approached the top of the cut and noticed the walls of the cut coming closer and closer together the farther away I visualized them. The sand of the road and the walls of the cut were the same color—a grey, slightly tinged with yellow. Then there developed, on each side of the cut, visual imagery of scrub oaks with dead autumn leaves hanging from the tips of the branches; there then appeared autumn leaves scattered over the ground beneath the trees. The uppermost portions of the trees faded into nothing. I saw no line or skyline. As this imagery persisted and I found my visual attention wandering from one detail to another, I noticed that it was tri-dimentional, i.e., I saw parts of trees extending back and behind the trees which were in front. The leaves on some of the nearer trees now developed here and there into relatively clear-cut forms and outlines, but I still visualized the distant leaves as mere dashes or 'daubs' of brown. The leaves on the ground remained, throughout, areas of mottled or speckled brown with definite outlines of only one or two individual leaves here and there. In each instance I found that the definitely outlined leaves were those upon which I was directly fixating my visual line of regard. As to the trunks, I visualized their general form and size but was not aware of minute detail of bark or color. (I can, however, construct visual imagery of tree trunks in which there appears a wealth of detail even to the nature of the bark and various vegetative growths such as moss and lichens.)"

9. *Observer B.* Same instructions. "(I visualized a scene at Cripple Creek, where I lived as a boy before my accident.) I first obtained a very sketchy visual image of the first school which I attended and of the Catholic church which stood behind it. The only distinct features of this imagery consisted of the bronze railing around the roof of the school building and the windows of the upper story, in front, as one would view them when standing in the street below. Accompanying this visual imagery was very distinct kinaesthetic imagery of eye-movement and strain of eye fixation upon the object visualized. There then appeared in very sketchy and fleeting fashion visual imagery of a dark, green mountain range which loomed up in the background beyond the school, and beyond the mountain was a faint suggestion of blue sky. All of this latter imagery was momentary and appeared like a tachistoscopic flash and was gone again. I found that I could revive it only by concentrating my visual attention again upon the bronze railing of the schoolhouse. Thereafter further attempts to retain this visual imagery resulted only in masses of kinaesthetic and tactual imagery. (I find that I am totally unable to visualize a neck-tie or other object either in this green or in this blue which momentarily appeared in my visual imagery. The colors have vanished and I cannot reinstate them.)"

[Instructions: Visualize a printed word.]

10. *Observer A.* "(I visualized the word 'the.') I was at once able to construct fairly satisfactory visual imagery of the three letters, *t, h,* and *e,* in print. They were not, however, printed upon any particular material or surface; they appeared in a visual setting consisting of that neutral grey background which so often surrounds my visual imagery. The 't' was a small letter, not a capital, the form and outline of which were very distinct, and were colored a reddish brown of only a poor saturation—the same reddish brown which always means 't.' The 'h' lay on the same background as the 't' and next to the 't' on its right, but this imagery was so faint as almost to merge into the grey of the visual setting; the form or outline of the 'h' was equally as indistinct as the color. Then I very clearly visualized the 'e' lying just to the right of the 'h'; it was the most distinct of all the letters and was likewise the most brilliantly colored. In fact, the color was the most distinguishing feature of the 'e' and that feature which dominated consciousness when I was attending to the letter. The exact shape of the curved lines which constituted the 'e' was the least clear of any of its features. (The color and brightness of the letters were the same as they always appear whenever I have verbal imagery or perceive these letters in any fashion.) After this imagery appeared I then set about attempting to visualize these letters printed in black ink. I found that I could thus visualize them in the type which is used in a child's primer; the letters resembled those which are emphasized in heavier print in order to represent the silent letters of a word. These letters appeared at about a reading distance from me. Hovering about the 'E,' which was the least clear of any of this visual imagery, was a halo of the same bright color which appeared in my previous visual imagery of that letter; this color identified the letter as 'E'; the printed 'E' looked as if the surface on which it was printed had slipped just as the 'E' was being stamped upon that surface—it was blurred and the outlines of the letter were ragged. The form and outline of the 'T' stood out fairly plainly in this latter visual imagery but were tinged with the same color as appeared in my previous imagery. The 'H' was again very indistinct and tended to merge, as before, into the grey setting. (The color for 'H' closely resembles the grey of the visual setting, which explains why it is not clearly distinguishable from the background.) The setting for this latter imagery was identical with the previous visual background. The longer the imagery persisted, the more the form and outline of the letters tended to give way to increasing clearness in the colors which aways stand for these letters. I found it impossible to make the letters remain black."

11. *Observer B.* Same instructions. "(After trying for some time to follow the instructions I reported that I could not visualize printed words.) Upon trying for some time to fulfill the instructions I found that my efforts resulted only in obtaining tactual-kinaesthetic imagery with only vague suggestions now and then of visual imagery in connection with a visual-kinaesthetic and schematic spacial image. I found myself having a wealth of tactual-motor imagery of writing my name in script, which I often practice in order not to forget it. If I eliminate this tactual-motor imagery I am able to obtain vague, fleeting schematic visual-manual-motor imagery of my name as if it were being written by an invisible hand. I also find imagery with incipient eye-movement of following what I remember, vaguely, to be the general shape of the letters, but I am unable to visualize anything where the invisible pencil has just traversed—no pencil, no hand, nothing except the spacial and schematic movement of tracing the form of the letters. I found that I could visualize a vague point or spot along the outline of the letter, which moved continuously over the letter, but the space over which the moving point had just traversed disappeared as the point moved on to another position. Thus the letter disappeared as fast as it was formed. All of my imagery was tactual or motor except the spacial representation of a point along the letter as it was being written. Peculiarly, this point did not move upon a visualized surface; it merely moved, that is all. (Thus I fear that my visual imagery of letters is but a visual-kinaesthetic-schema.)"

[Instructions: Visualize a cube.]

12. *Observer A.* "I was able to distinctly visualize a cube, the edges of which were about three inches long; it was localized in space, about at arm's length, and directly in front of me; in this imagery I saw at one glance the surfaces which are ordinarily visible when one corner—here an upper corner—is directly in front. My line of regard was fixated upon this corner. Extending definitely in three different planes were the upper surface of the cube, a more or less broadside view of the front surface, and the diamond-shaped right side, appearing in perspective. Of these three surfaces the top was the clearest. From the color of the cube I interpreted that it was a light yellow block of wood which I was visualizing. The surfaces were smooth; all four edges of the top were visible but the edges of the front and side surfaces were less distinct. The object was of uniform color and brightness throughout except at the juncture of two planes where the edge was represented by a shadowy line of darkened wood color rather than by clear-cut, sharp corners. I noticed that no other form of imagery other than motor imagery of eye-movement tended to appear; I had no tactual or kinaesthetic imagery of handling the cube. (Under instructions to visualize an object which I have not inspected tactual-motor fashion recently, I find my attention almost wholly absorbed in visual and eye-motor experiences and with the shape, form, and color quality of the imagery.)"

13. *Observer B.* Same instructions. "I found myself tending to visualize a die. There appeared faint, fleeting and very schematic visual imagery of a small, cube-like form, three sides of which, including the top, were visible. The sides were light—the quality of a very light and dim grey, I think; the edges were darker. There was no visual setting; the object appeared in space before me but with nothing visualized around it, and on the faces of the cube there appeared faint, pencil-like dots which represented the spots on the die; these spots were mere points of brightness and stood out as specks a little darker than the adjacent surface. I could not count the spots for they were not clear enough nor were they definitely distributed, but together with this visual imagery I found myself saying in verbal imagery, 'one, six, two, five,' etc."

[Instructions: "I am going to read you a certain selection of prose. Attend to this reading as if you were going to be called upon later to recall what was read to you and attempt to translate the meaning of the passage as far as

possible into visual imagery. After I have finished the reading begin at once to introspect particularly upon the visual imagery which was aroused while you listened. Do not make such an effort to visualize the meaning of the passage, however, as will distract from following its discourse.. Ready."]

The passage was from Parkman's "Oregon Trail," Standard English Classics edition, edited by W. E. Leonard and published by Ginn and Co., and is found on page 56, lines 5-23. The passage is as follows:

"A low, undulating line of sandhills bounded the horizon before us. That day we rode ten hours, and it was dusk before we entered the hollows and gorges of these gloomy little hills. At length we gained the summit and the long-expected valley of the Platte lay before us. We all drew rein and sat joyfully looking down upon the prospect. It was right welcome; strange, too, and striking to the imagination, and yet it had not one picturesque or beautiful feature; nor had it any features of grandeur other than its vast extent, its solitude and its wildness. For league after league a plain as level as a lake was outspread beneath us; here and there the Platte, divided into a dozen thread-like sluices, was traversing it, and an occasional clump of woods, rising in the midst like a shadowy island, relieved the monotony of the waste. No living creature was moving throughout the vast landscape, except the lizards that darted over the sand and through the rank grass and prickly pears at our feet."]

14. *Observer A.* "I was first aware of visual imagery of the sand hills, looming up one behind the other like a series of terraces, the hills in the distance rising up behind those in the foreground. All were colored a very faint washed-out yellow, like the sands of the western deserts, but possessed no detail; they were colored as if painted by a thin wash of water-color paint. The only variations in this color appeared along the ridges of hills and along the sides of higher ridges behind, thus marking off in my visual imagery in terms of a shadow the place where the summits of the nearer hills left off and the slopes of the hills farther back commenced, or loomed into view. This imagery lingered in consciousness but a brief moment and then the scene changed. I found myself standing on top of one of these foothills; portions of ground were visualized at my feet, in this same color, while off in front of me and extending as far as I could see, was a visualized plain. The plain was colored much as were the hills and here again, in the imagery, were no details—merely a broad expanse of surface—except where I visualized the Platte river winding hither and thither, becoming smaller as it extended farther and farther into the distance. Then for a brief moment I had visual imagery of nearer views of the Platte. First there appeared visual imagery of the river as one might see it from a train as one travels along near the bank. (This imagery, I think, is a vague memory image of a view I once obtained of this river when on my way west years ago.) In this image I saw about as much as one would ordinarily see from a point of view several feet away and slightly elevated above the level of the banks. The water was not colored but had a white or silvery glare as if brilliant sunlight were being reflected from its surface. The water seemed motionless at first; in fact, there was no motion in the imagery beyond a slight suggestion of currents of water which later appeared when I heard the word 'sluices.' At this juncture I had visual imagery of the Platte dividing into several sluices and at the nearest fork there appeared streaky-like shadows on the surface of the water which represented to me the dividing currents. The scene then changed again, I visualized hill after hill, passing me as if I were being silently carried through space at a terrific speed; after several hills had passed I then visualized a broad, flat, open area passing by; then would come a long, undulating ridge, colored as the foothills which I saw at first. This scene would give way to another broad, flat area of plain where nothing was visible except the yellowish-grey sand, smooth and unvaried by any detail. The next imagery of which I was aware consisted of visualized lizards darting across the sand at my feet, as if I were standing on the open plains. These lizards appeared as small, dark,

oblong forms, about four inches in length and in each my line of regard was centered upon the region of the hind legs which were represented in my imagery by short and slender extensions of the dark brown oblong forms. Between these slender extensions was a long slender streak, almost black, which represented a tail. Then I found myself visualizing tiny gusts of sand thrown up backwards and sidewise by the hind feet of the lizards as they scurried over the ground. I had several visual images of this sort, some of which were localized near me and others of which were projected off in the distance, on the ground, for several feet. These little gusts of sand would appear first on one side, then on another, as if I were running upon these little animals while travelling across the plains, although I was not aware of imagery of walking or of otherwise moving, myself. Once I fleetingly visualized a clump of trees off in the distance, in a desert setting, but here the imagery lacked detail. When I heard the words 'prickly pears' I at once had visual imagery of small, cactus-like plants, standing up about 18 inches high and growing up from the smooth, yellowish sand. This imagery included a greenish-grey stalk with spines protruding here and there of lighter color but of the same hue; I saw no branches, leaves or flowers. During the entire reading I had no tactual or kinaesthetic imagery beyond a slight awareness of eye-movement with the rapid shifts of visual attention from one object or position in my visual field to another. I saw no men, horses, or other objects.''

15. *Observer B.* [Same instructions.] ''As the selection was being read I was first aware of the stillness and the peace portrayed by the situation. This awareness consisted, I think, of an interpretation from total absence of tactual, motor or auditory imagery. Then I became aware, in terms of schematic visual-motor imagery, of the foothills near me. While I did not see the hills in this imagery, this awareness consisted of vague shadow-like lines with no visual setting, which shot hither and thither through space before me, and which were accompanied by marked tendencies for my line of regard to follow them. Here I was distinctly conscious of kinaesthetic imagery of eye-movement with incipient motions in my eyes. There also occurred incipient tendencies to follow these shifting lines with movements of my head. I then had a diffuse tactual image of coolness upon my face. Then I was aware of a peculiar complex which I interpret as a consciousness of romantic grandeur, depicted by the passage. This consisted of tendencies to breath more slowly and deeply, of a peculiar tenseness about the region of my diaphragm, together with tactual imagery of the warmth of the sun upon my face and back and faint pressure imagery of a breeze blowing against my face. These experiences gave way to a wealth of tactual and motor imagery of riding a horse across the plains and over the hills. I had very persistent and clear kinaesthetic imagery together with incipient bodily swaying movements of balancing myself in the saddle as the horse seemed to bound up a steep grade or now across a rough section on level ground. Then I would become momentarily absorbed in kinaesthetic imagery of rough jolts from a sudden change in the horse's stride or from an unsually long jump across, perhaps, a stream. There then appeared a wealth of tactual and kinaesthetic imagery of shifting my position in the saddle; auditory imagery of the crackling of dry grass beneath the horse's feet; incipient tensions in my legs as if I were pressing my feet against the stirrups; then I would have tactual and kinaesthetic imagery of suddenly pulling upon the reins, localized in my hands, arms and shoulders. Also I had tactual and motor imagery of the rhythmic bodily movements of trotting, of galloping, and of walking. Then I had tactual imagery of my shirt as if it were being blown tightly against my body by the wind; then came auditory imagery of the panting of the horse; auditory imagery of the splashing of its feet as we passed over boggy places; then, later, I had tactual imagery, localized at the bottoms of my feet, of stepping upon prickly pears, with cutaneous and gustatory imagery of handling and tasting the cactus. All of these experiences were intermingled with a wealth of affective

and organic states consisting of circulatory, respiratory and other muscular changes. These latter processes seemed to constitute an awareness of the expansive openness about me. In no instance, beyond the faint suggestion at first, did I have any sign of visual imagery."

The following introspection from observer *A* is here introduced in order to show the influence of tactual and motor processes in his imagery of objects recently handled.

[Instructions: Visualize the rifle which I showed you the early part of the morning. Then give me a detailed introspection on the imagery involved.]

16. *Observer A.* "As soon as the experimenter said 'rifle' I was aware of visual imagery of that section of the rifle which surrounds the hammer, the breech and the trigger, also back along the grip of the rifle as far as the peep-sight and ahead on the rifle as far as the opening from which the cartridge is extracted by an automatic device. This imagery was localized in the direction of my knees as if the visualized object were resting across them, with the barrel pointing to the left. Then my attention flitted momentarily to the under side of the rifle where I visualized the hole and spring-shutter through which one fills the chamber. This visual imagery was more stable although, I think, no clearer than visual imagery which I have described in previous sittings. I saw at one glance the two blocks at the lock in the breech, the hammer, part of the iron ring beneath the trigger and the trigger itself. Then there appeared, as this imagery persisted, tactual and motor imagery of placing my finger through the lever behind the trigger and my thumb upon the hammer; in this latter imagery the feature which stood out most prominently was the quality of strain involved in pressing the hammer back and down, with my thumb, as if in the act of cocking the rifle. This quality was localized both in my thumb and wrist. But no sooner was I aware of this motor imagery when I found my attention shifting from kinaesthetic qualities to visual associates which always accompany my kinaesthetic imagery. These latter consisted of black streaks and areas localized in my finger and thumb, also in my wrist, representing the muscular strain. Then this visual imagery changed to further visualizations of my finger and thumb in their positions as just described and here it was the musculature itself and not the synaesthetic process which was present in terms of visual processes. The portion of the barrel which I first saw was colored the quality of blue steel; the hammer was somewhat the same color but lighter while the tip of the peep-sight was almost white. I did not visualize the wood-stock and at no time did I have tactual imagery of the coldness of the metal or of pressure from gripping the rifle. (This visual imagery differs from my imagery of objects which I have not handled recently in that it is not broken up into disconnected sections or patches as is true of the former where kinaesthetic processes are lacking. This observation confirms many others which I have made in the past.)"

ii. Summary of introspective data on visual imagery.

Observer A. Under the instructions to visualize various situations or objects, observer *A* readily experienced combinations and successions of visual imagery to the exclusion of practically every other type of imagery with the exception of the kinaesthetic. This visual imagery was invariably rich in color or brightness qualities but lacked other details such as definiteness of outline and quantity of items visualized. As far as color and brightness were concerned

his visual imagery seemed to possess such persistence and clearness as characterize similar imagery in a good visualizer. On the other hand *A's* visual imagery tended to be photographic; and where large objects were visualized, or where extensive scenes were imagined, hills, deserts, plains, rivers, rocks, trees and the like appeared "washed" with color. The shapes and outlines of objects were suggested by variations in quality or shade of color and brightness rather than by edges or lines.

Another prominent feature of *A's* visual imagery consisted of its patchy or disconnected character. Images, varied in number and in the objects which they represented, appeared in consciousness either in groups or in rapid successions but in either case this imagery tended to be discontinuous and to be separated by areas of a dark grey neutral background. For example *A* described visual imagery of rose-buds, ferns, a box, various parts of the human face or figure, various portions of a landscape, but each detail or each individual object tended to be separated from its neighbor by an indistinct and almost indescribable "space" or by an area of greyish visual setting. In the same fashion successions of visual imagery were broken up by short intervals in which *A* was conscious either of this grey visual setting or of other types of imagery such as tactual and kinaesthetic. One visual image or short succession of visual images would vanish before the succeeding group of visual images would appear, the reagent's attention meanwhile being occupied by other imagery, chiefly this visual setting. This state of affairs is not different, perhaps, from the behavior of visual imagery in a sighted person. For when one experiences successions of visual processes either sensory or imaginal he will undoubtedly discover that when one visual image fades away before the next image appears, his attention, in the interim, may be occupied by a "blackness" of indefinitely visualized space.

There are instances, however, when observer *A* is able to experience long trains of visual images in which one image merges without a break into its successor. Such instances, however, are rare except when synaesthetic phenomena are functioning, or when visual imagery constitutes a temporary schema or form, resembling, in character, a number form. Again, in case tactual or kinaesthetic processes accompany the visual imagery, the latter become less patchy and more persistent or stable. These facts are signifi-

cant in connection with the functioning of synaesthetic phenomena for the reason that they demonstrate the striking difference between the behavior of visual imagery of objects or scenes as such and the behavior of that visual imagery which functions in *A's* synaesthetic processes. The latter are differentiated from the former, as we shall observe later, by greater persistence, stability, by a stereotyped character which is not found in "normal" visual imagery, and by their peculiar functioning in the development of meaning.

Synaesthetic phenomena appeared in connection with *A's* visual imagery of a person whom he had not met for several years, in connection with kinaesthetic imagery of handling a rifle and in connection with visual imagery of printed words or letters. It is of striking significance that the patchy visual imagery of professor *O's* ears, forehead, chin, and clothes (see introspection 6) was colored by the same yellow which is always aroused when professor *O's* voice is heard. In the winter of 1914 observer *A* heard his voice for the first time and it at once assumed this peculiar yellowish-buff color. Auditory imagery of his voice and visual imagery of him at once took on this same quality of yellow. In the winter of 1917 this color was described by observer *A* as a faded orange-yellow; during the winter of 1919 this color was described as a light brownish yellow and at the present writing this color is a "washed-out yellowish tan." Every form of imagery pertaining to professor *O* is affected by this synaesthesia and the imagery itself, if wholly visual, is colored by this yellow. Auditory imagery of professor *O's* footsteps are invariably yellow; if *A* is thinking of a book which *O* has written either the visual imagery of the book itself or the background on which the book is visualized takes on this same quality of yellow. Observer *A* has a century form which he constantly uses in connection with historical dates or epochs. A certain section of this century form, representing a period of time extending from the year 55 B. C. to the Saxon period in English history, turned yellow as a result of *A's* having studied English history under this professor. Previous to taking this history course with professor *O* the section in *A's* century form, just referred to, was white. In like manner all memory imagery having to do with courses taken under professor *O* is affected by this same

yellow. The following quotation from observer *A's* recall of certain facts concerning Gregory, a missionary to England, illustrates the point in question.

16. *Observer A.* "(If I were asked about Gregory, a certain missionary to England, and about his nationality and the time during which he visited England, my synaesthetic imagery would function as follows:) There first appears, in response to the verbal image of 'Gregory' a black splotch in the center of my field of vision; this blackness means 'Gregory,' while surrounding this black splotch there appears a band of yellow which means that I studied about Gregory in a course under professor *O.* The black informs me that the person represented is not only Gregory but that this person was either a Roman or an Italian. The yellow has come to mean, also, that Gregory is associated with England during the Saxon period. Thus, in order to place Gregory in the Saxon period of English history it is only necessary for me to call up my century form whereupon the black splotch which means 'Gregory' at once assumes a position in the form corresponding to a date falling somewhere in the middle of the eight century. On both sides of the black splotch there remains the yellow of professor *O.* (This is a fair test of the functioning of my 'professor-*O.*-yellow' for I have not studied or reviewed my English history for several months. What I can remember about Gregory is entirely represented in the behavior of the colors as described.)"

In the second instance—that of visual imagery of letters—we find a similar state of affairs. For example, the visual image of "t" appeared in the form of a printed "t" but its shape or form was indistinct. The distinct feature of the "t" was its reddish-brown color, and it was upon this color which observer *A's* attention was directed in the image. Similarly, the "h" lacked definiteness of shape or form but the important feature of the image consisted of its greyish brightness which very nearly blended with the visual setting upon which the "h" was projected. The shape and form of the "e" were also vaguely visualized but the light, dull white of the "e" stood out in focal attention. In 1917 *A* described the color of "t" as a dark chocolate brown; in 1919 this color was a dull brown; in 1921 it was a reddish-brown. Slight variations in the verbal descriptions of these colors may be traced to the use of different adjectives in successive introspections and the actual colors themselves may vary, slightly, when the letter occurs in various associative settings. The significant feature of *A's* visual imagery of letters, however, is the fact that in each letter this colored imagery is present, no matter what its setting happens to be, or no matter under what conditions the letters are visualized as long as the letters retain their individuality, *i. e.*, their individual meaning. Introspection number 10 quoted above is thor-

oughly typical as a demonstration of synaesthetic imagery in connection with letters.

In the third example of synaesthetic imagery which we found in *A's* introspections quoted above, it was kinaesthetic imagery which was associated with a degree of brightness and here the synaesthetic image was a deep black. A mass of introspective data definitely showed that the intensity of the black was proportional to the intensity attribute of the kinaesthetic image and that the size or area of the blackness was proportional to the amount of musculature involved in the kinaesthetic image. This peculiar black is typical of all of *A's* kinaesthetic processes whenever and wherever they occur.

Observer B. In contrast to the vast amount of visual imagery in observer *A*, *B* has very little imagery of this type. The few visual images which *B* was able to recall were exceedingly vague, fleeting and schematic. Imagery of color was limited largely to the greens with only a rare appearance of other hues. Brightness qualities far outnumbered color qualities. *B's* visual imagery, also, was exceedingly patchy and disconnected and was invariably supplemented or "filled out" by tactual and motor processes. Once a flashy visual image appeared it seemed to melt away or dissolve into a tactual and kinaesthetic setting. *B* found it impossible to control this fleeting imagery other than by resorting to cutaneous or motor cues and even under these conditions he could rarely succeed in reviving a visual image after it had once run its course. One striking feature of his visual imagery consisted of its shadow-like nature together with its lack of definite limits or boundaries. Another consisted of its appearance in space in the absence of a visual setting. It was projected in space but around the image was "nothing"—the "nothingness" which a sighted person has great difficulty in understanding. It is the visual "nothingness" the significance of which one can imagine, perhaps, by contemplating upon what he cannot see "back of his head." But *B's* visual imagery did not appear in an entirely negative setting for tactual or kinaesthetic imagery took the place of the extended visual field of a sighted subject and of our other blind reagent. A third prominent feature of *B's* visual imagery consisted of its confinement to visual-kinaesthetic schemata. Much of *B's* awareness of space consists of these visual-motor schemata in which extendedness

or movement is simultaneously "seen" and "felt" in imaginal terms. But these spacial schemata very seldom include visualized objects.

iii. Visual imagery of A and B compared.

1. *A's* visual imagery is characterized by a wealth of color and varying degrees of brightness. *B's* imagery is confined very largely to brightness qualities alone.

2. *A's* visual imagery far exceeds *B's* in stability, persistence and complexity of behavior.

3. *A* possesses a remarkable control of visual imagery. *B* has almost no control of his visual images.

4. *A's* visual imagery appears in visual settings. *B's* appears in tactual and kinaesthetic settings.

5. Visual imagery is nearly always ushered into consciousness in *B's* case by vocal-motor, tactual or by kinaesthetic imagery. In *A's* case visual imagery itself may function as the stimulus or cue by which further visual imagery is aroused.

6. *A's* visual attention is confined to changes in hues, brightness, position of the image, or to shifts in size, shape and distance of projection and does not involve definite changes in clearly visualized outlines, edges, limits and similar differentia. *B's* visual attention is dependent upon the effectiveness of tactual and motor cues in producing changes in size, shape, hue or brightness.

7. The visual imagery of both reagents lacks minuteness or nicety of detai.l While *A's* visual imagery has remained rich in brightness and color qualities, owing perhaps to his entoptic phenomenon, hues and brightness qualities take the place of definitized outlines, limits or boundaries. In this respect *A's* visual imagery varies from that of a good visualizer. *A's* visual imagery differs from most sighted persons' and also from *B's* visual imagery in that it possesses a synaesthetic function. Definiteness of form and outline in *B's* visual imagery is provided for by tactual and kinaesthetic processes.

8. Both reagents agree that their visual imagery is more stable or persistent and that it possesses greater continuity when supplemented by tactual or kinaesthetic processes. Both reagents also agree that visual imagery of objects recently inspected or capable of being inspected tactual-motor fashion is far more stable

and clear than visual imagery of objects which cannot be so inspected. Whenever either reagent visualizes large objects or scenes those details stand out more clearly and persist longr which have been inspected through touch or movement. *B* is unable to "see" any object which he cannot or has not touched.

iv. The significance of A's synaesthetic imagery in processes of visualizing.

In order to understand the significance of the synaesthetic phenomena which occur in *A's* visual imagery let us resort to an analogy. Suppose one were to attend to the muscular contractions of clenching his fist. If one is a habitual visualizer he will visually localize these muscular contractions in the fingers and wrist. Again, if one's attention is suddenly attracted to a strain in the throat that strain will be localized visually. The kinaesthetic and visual elements may be simultaneously present to consciousness or at least very nearly so. In other words, part of the actual awareness of muscular strain will consist of a visual process. In other individuals who do not habitually visualize these motor processes it is conceivable that other factors such as verbal imagery or added motor phenomena such as head or eye-movement may be involved in the localization of muscular strain in the throat or wrist. The presence of these added processes whether or not they be visual facilitates the definite localization of the muscular strain in question. These supplementary processes function in the act of *perceiving* the strain. Without them it would be difficult to comprehend how the strain in question could be consciously localized at all. Again, let us examine the process of perceiving a distant locomotive whistle. One tends to turn his eyes or head slightly in the direction of the sound; perhaps he visualizes the distant source of the sound or characterizes the sound vocal-motor fashion. Also he may tend to analyze the muffled quality, or he may detect an echo, or he may note the greater definiteness of the sound as heard by one ear rather than the other, all of which supplementary processes contribute to his *perception* of the sound.

Returning to observer *A*, a mass of introspective material demonstrates beyond any possibility of doubt that *A* can no more "image" an arm-movement without seeing "black," or visualize a "t" without seeing reddish-brown, or visualize professor *O* with-

out that peculiar quality of light yellowish tan, than can an asynaesthetic individual become conscious of the direction from which a sound appears unless he tends to resort to such supplementary processes as visual, motor, verbal or other imagery. *A's* synaesthetic imagery functions exactly as these supplementary processes function—it is an integral part of the perceptual or conceptual process. So far as *A's* synaesthetic processes have thus been described they appear not as a new group or genus of mental activities but as a new species of an old and familiar genus—a species of *meaning*. For *A* the appearance of a light reddish-brown in response to the letter "t" means "t". The particular yellowish-tan aroused by a professor-*O*-stimulus means professor *O* and without this color observer *A* would be visualizing not professor *O* but an unrecognized or unidentified person. In a similar fashion, black, projected in the musculature while muscles are contracting, means "muscular" sensation and identifies that experience as a kinaesthetic one rather than as a tactual or an auditory experience. As a result, the original kinaesthetic quality of the experience tends to be ignored so far as the behavior of *A's* attention is concerned.

The significance of synaesthetic processes in *A's* case at least is far too great to be dismissed here with but one analogy. If an asynaesthetic individual were asked to visualize a person whom he had not seen for years he would find that his visual attention would be claimed first, perhaps, by a face in which certain features stood out more prominently than others. One of these features might be a peculiar color of skin, a mole, a mustache of certain shape, a certain degree of baldness, a characteristic wrinkle, or a combination of features. Together with this visual imagery there perhaps appears verbal imagery pertaining to past events in which this particular visualized person figured; or there is aroused an organic and motor complex which characterizes this visualized person as familiar. The possibilities are almost innumerable. But certain definite details are organized within the image complex itself or tend to crowd into consciousness together with this image complex and as a result the experience becomes that of a visual image of a definite, particular person rather than of some other person.

So, with our reagent. When he visualizes professor *O*, such details of additional visual, verbal or other imagery as have been described above are lacking but in their place there appears a particular quality of yellowish-tan. This color identifies the visual image as one of professor *O* exactly as the supplementary processes mentioned above identify a visual image in an asynaesthetic subject. *A's* attention is directed to a certain color quality rather than to a certain shaped chin, a certain profile, a peculiarly shaped mustache or what not. And furthermore, while *A* is visualizing this yellow-tan, it is a *familiar* yellow-tan in the same fashion as is a certain facial feature, in the visual imagery of the asynaesthetic observer, a *familiar* one.

A's so-called snyaesthetic images are but substitutes for a possible variety of secondary processes which occur under similar conditions in the asynaesthetic individual. They are substitutes, also, for the tactual and kinaesthetic secondary processes which occur in case of observer *B*. The functioning of synaesthetic processes is identical with the functioning of secondary processes in acts of perceiving or of identifying. Thus the functioning is the same in all cases although the mental "content" involved may radically differ.

Further evidence of the cognitive nature of synaesthesis may be found in *A's* introspections. In introspection 16 we found that *A* reported a kinaesthetic image which turned into a visual image of "deep black" localized in the thumb and wrist musculature. Under the proper conditions we found that *A* can be made to become aware of the "blackness" of muscular strain before he is aware of the kinaesthetic quality itself. In fact it is the *Aufgabe* which determines which of the two qualities—the black or the strain—shall be attended to first. If the strain claims attention first there is invariably a shift to the visual black. If the visual black is the first to claim attention in any given instance it may happen that the quality of strain fails entirely to develop; in fact it may be ignored entirely unless it happens to persist. Thus it happens that when the visual associate appears in the absence of its parent process (here the parent process is the kinaesthetic quality of strain) a black streak or area localized in the musculature *means* a localized strain quality. That is, in the presence of the appropriate mental set or preparedness, black may

mean muscular strain in the absence of any intimation of the strain itself.

This and much other evidence shows conclusively, we believe, that when two imaginal processes appear together in consciousness, such as a visual black and a kinaesthetic strain, we have a clear case of synaesthesia but with the difference that the stimulus is not now a peripheral one as in case of the so-called synaesthesia proper. In case of synaesthesia the stimulus is a sensation. In the case of the black muscular imagery the stimulus is an image. The same is true of colored imagery of professor *O* or of different letters.

b. (Series 1 continued.) Auditory imagery.

i. Typical introspective data.

[Instructions: Call up auditory imagery of professor (X) saying at the close of a lecture: "The next natural division seems to be from thirty-one to fifty-one; take that for next time."]

17. *Observer A.* " I tried for some time to recall Prof. *DeB's* voice as he might repeat these words but was unsuccessful. I simply found myself experiencing auditory imagery of the experimenter's voice as he repeated the instructions together with the peculiar light, silvery grey patches which always accompany auditory imagery of the experimenter's voice and auditory perceptions of his voice, as well. In order to imagine how professor *DeB's* voice sounds I found it necessary to inhibit my own vocal-motor imagery. My own vocal-motor imagery, which tended to appear, produced series of visualized colors on which I could not prevent my attention from lingering. By keeping my own vocal-motor imagery inhibited (this I accomplished by tensing the muscles of my throat) I was able to recall a few very fleeting and sketchy auditory images of *DeB's* voice, such as the words, 'Pardon a personal reference,' which I often used to hear him say during his lectures. Each word was of very short duration and by the time the second appeared the first had vanished entirely; the timbre was, as such, indistinguishable form the dark, reddish brown color which always identifies his voice. The imagery seemed to be 'pinched'; he was speaking as if he were hurried or slightly embarrassed; on attending closely to the visual qualities of his voice I was able to obtain more definite auditory imagery; the enunciation became more distinct; the quality was less muffled; and his speech seemed to take on the quality of his lecture voice as I have heard him from a distance of 30 or 40 feet. I was then aware of visual imagery of his teeth but I saw nothing of his facial features, of his clothes or of his general appearance. During all of this time I was dimly aware of the persisting strains in my throat from inhibiting my own verbal imagery. The dark reddish brown synaesthetic imagery persisted throughout and it was by means of this latter imagery that I was able to describe the auditory qualities of his voice. Both auditory and visual qualities were present to consciousness but the visual qualities were invariably the claimants of my attention. When I attempted to analyse the auditory qualities as such I found that I was always resorting to features of my visual imagery."

18. *Observer B.*. Same instructions. " I could readily obtain distinct and persisting auditory imagery of the statement just quoted in terms of Mr.*M's* voice. The quality was good; each feature of the imagery was clear and rich in detail. I detected the liquid suavity which is strikingly characteristic of Mr. *M's* voice; I noticed characteristic pauses between each of his words

and even heard him utter his peculiar 'ah' sound between the phrase 'fifty-one' and the word 'take'. Articulation in my auditory imagery was characterized by marked definiteness; the pitch stood out with equal clearness. While this imagery was presenting itself I tended to imitate his voice in vocal-motor fashion, emphasizing the words as I imagined Mr. *M* emphasizing them. So clear was the imagery and so qualitatively perfect that I at once found myself saying in vocal-motor imagery: 'that is certainly Mr. *M*. all right'."

[Instructions: Recall some familiar tune. Can you hear yourself singing it? Can you hear it played upon the piano? Can you hear it played on the violin? Can you hear a chorus singing it?]

19. *Observer A.* "For a considerable length of time I tried to select a tune which I could hear in terms of auditory imagery but was entirely unsuccessful. Finally I thought of 'Yankee Doodle' and centered my attention upon it. The quality of my auditory imagery was very poor and indistinct and was confused with vocal-motor tendencies which latter were exceedingly strong. What little quality of tone was present seemed to be hoarse and muffled with only a faint suggestion now and then of the timbre of my voice. I was able to recall imagery of only the first few measures of the tune. Then the auditory imagery vanished and I found myself attending to a strained condition in my throat as if I were still trying to innervate the notes. Together with this auditory imagery of my own voice I was distinctly conscious of the color qualities which always accompany my own voice when I actually speak as well as when I have auditory imagery of my voice; I was also aware of spots of visual 'brightness' which represented the notes I was endeavoring to sing. I noticed, further, that my auditory imagery was slow, labored and 'dragged out' and that the colors brightened with rises in pitch and darkened with lowerings in pitch; in fact differences between one note and another were marked off much more by vocal-motor imagery and by changes in these colors than by variations in the auditory qualities themselves. The colors lingered after the auditory imagery itself disappeared but along with these persisting colors I was aware of persisting vocal-motor efforts of preparing to make musical sounds. The color of the imagery was a thick, smoky blue which appeared in small, cloud-like forms. When my imagery changed pitch these cloud-like forms not only brightened or darkened but tended to roll upward for higher pitches and downward for the lower notes. So closely was the visual imagery associated with the auditory that I could hardly tell the one from the other. When I thought that I was describing actual sound qualities I discovered that I was describing qualities or behavior of the visual accompaniment. Yet I was able to tell when the auditory processes themselves dropped out because of a dulling and shrinking of the visual processes themselves. After considerable effort I found it utterly impossible to imagine Yankee Doodle played on the piano or violin. It was equally impossible for me to hear voices singing this tune."

20. *Observer B.* Same instructions. "(I recalled the tune of 'A Heart Bowed Down.') I could hear myself singing this tune with a rather satisfactory degree of clearness but noted that, throughout, vocal-motor tendencies were very strong. While my auditory processes were clear and presistent, they were characterized by a 'deadness' or lack of richness of quality; the timbre was shallow and lacked resonance. I could not imagine the tune played on a piano but had definite auditory imagery of a violin playing the melody. Here the imagery was clear, intense, persistent and of good quality. I distinctly heard the stringy or twangy quality of the tones; also the rich, smooth, mellowness of a good instrument. Nevertheless the quality seemed to lack 'point', which, I believe, must be inability to detect the finer features of a violin tone in terms of imagery, alone. (I persume that I am comparing the quality of my auditory imagery with the quality of auditory perceptions of violin tones when I characterize the quality of my auditory imagery as lacking in 'point'.) Along with this latter auditory imagery I had very clear and definitely localized

kinaesthetic imagery of playing a violin, together with a very fleeting and schematic visual, shadow-like image of the movements of an unseen bow across a vaguely localized spot where the strings might have been. The shadow appeared in space but had no visual setting whatever. Its setting was the motor imagery which I have just described."

[Instructions: Recall auditory imagery of a chorus singing an oratorio or of an orchestra playing.]

21. *Observer A.* " I was unable to recall auditory imagery of a chorus but succeeded in obtaining sketchy auditory imagery of an orchestra playing the Overture from Poet and Peasant..... The first auditory imagery was that of a flute playing a succession of very rapid notes somewhat toward the latter half of the selection but at just what place I am unable to tell. I heard only a few of the very highest notes. For not more than three or four notes in succession there appeared the characteristic mellow, wood-like quality, intimately fused with tiny, blue, cloud-like forms, which latter rapidly piled upward and upon one another as the flute tones shifted upward in pitch. All of this imagery was exceedingly flashy and fleeting and gave way to similarly fleeting auditory-visual imagery of violin tones. The violins were apparently playing the same notes as did the flutes, for the behavior of the visual forms was similar. I knew that my auditory imagery had changed from flutes to violins for the reason that my visual imagery changed from the tiny blue clouds of smoke which meant flute tones to mahogany-brown cloud-like forms for the violins. These colors also varied in brightness as the tones varied in pitch. Next I was aware of sketchy auditory imagery of horns playing at a much lower pitch and I saw the characteristic yellowish-grey splotches which mean horn tones. I found it impossible to begin at the beginning of the selection and to hear any considerable part of it played. In the absence of any auditory imagery at all, however, I can obtain long and persisting successions of visual images—varying colors and brightnesses—which mean different portions of the selection. The quality of this imagery represents different qualities of tones, *i. e.*, different musical instruments; the behavior of this imagery represents rapid runs, chords, varying pitches and the like. It is all so fast and complex that I cannot fix my attention upon any one group of images long enough to describe them in adequate detail. (This imagery, however, is definitely distinguishable from the colors and brightness of my visual, sensory field.)"

[In order to ascertain whether this visual imagery was at all faithful in representing different portions of the overture, the experimenter subsequently played the overture to observer *A* on the piano. Since *A's* imagery stood for orchestral rather than for piano tones, the piano tones changed the quality of *A's* memory images of the selection. Nevertheless *A* was able to recognize the outstanding features of the overture in terms of recurrences in this characteristic behavior of his visual synaesthetic processes. The piano rendition stimulated shiftings in visual imagery, and peculiar successions or flights of visual forms just as had an orchestral rendition done in the past. *A* repeatedly detected similarities between the behavior of his visual forms during the piano rendition and the behavior of these forms (although differently colored) in the auditory recall of the orchestral rendition. Moreover, the detached visual imagery, described in introspection 21, was recognized so far as its behavior was concerned during the hearing of the selection on the piano. There is no doubt, therefore, that synaesthetic imagery, detached from its parent processes, may be as faithful to the original selection as is the auditory imagery itself, in an asynaesthetic subject. Added evidence fo this fact may be found in the circumstance that observer *A* recognized in terms of behavior of synaesthetic imagery certain sections of the overture which he was unable to revive during the voluntary recall.]

22. *Observer B.* Same instructions. " I recalled auditory imagery of a chorus singing Mozart's 'Twelfth Mass'. There first apeared very clear and beautifully toned imagery of the opening bars. The voices were well blended,

the tenors, however, dominating. Along with this auditory imagery I found myself tending to join in the singing in terms of auditory-vocal-motor imagery of my own voice. The quality of pitch stood out clearly in the auditory imagery of the voices; each voice seemed to be directly on the pitch and the tones were well rounded, full and resonant. After the first few bars all voices dropped out except the tenors whom I heard singing for several additional measures. Then I was aware of intensive muscular contractions about the chest as if I were beginning to take a very deep breath; I had a peculiar tenseness in the region of my diaphragm, a widely diffused feeling of exhilaration which consisted of tendencies to sit more erectly in my chair and to sway my head and the upper part of my body to the rhythm of the music. There was also a contracted condition of the shoulders, arms, back and throat as my whole bodily attitude became tense. Thereupon there burst into consciousness loud and penetrating auditory imagery of the entire chorus singing 'Glorious'; at this juncture I was dimly aware of inhibited breathing; of marked pleasantness, coincident with tendencies to smile. (These latter experiences I interpreted as a consciousness of the grandeur of the music.)"

[Instructions: Recall auditory imagery of a locomotive whistle.]

23. *Observer A.* " I can obtain no auditory imagery of the whistle. Instead there appeared very vivid visual imagery, first, of a floating cloud of beeswax-yellow which represented a certain freight whistle I have often heard. There then appeared a blue and grey mixture which stood for a passenger whistle. Each was labeled in terms of auditory-vocal-motor imagery. In neither instance, however, could I obtain any auditory qualities whatever."

24. *Observer B.* Same instructions. "I at once had a very clear and intense auditory image of a locomotive whistle; the sound was loud and shrill but persisted for only a short time, together with the quality, which was harsh and piercing. I was conscious of a distinct feeling of unpleasantness. This latter consisted of tenseness about the chest muscles, of tendencies to frown and of an expansion somewhere in the region of the abdomen which I think were concerned with tendencies to breathe more rapidly. I also noticed a tightening about the jaws. All of this was accompanied by a clear but sketchy auditory-vocal-motor: 'Gee, that's loud!' (I reacted to the auditory imagery just as I would have reacted to an actual whistle but with a lesser degree of intensity.)"

ii. Summary of introspective data on auditory imagery.

Observer A. Notwithstanding the fact that observer *A* is blind and that we might therefore expect his auditory imagery to have been developed by means of constant use in every day life we find on the contrary that this type of imagery is exceedingly fleeting, vague, sketchy and meager as regards detail. *A* is unable to recall in auditory terms many sounds and noises which are perfectly familiar when perceived. Because of its vagueness of timbre and pitch, its brief duration in consciousness and dearth of detail, auditory imagery is subject to only slight voluntary control. This control is secured very largely by means of detached visual synaesthetic images which suggest their parent auditory qualities and at times by means of vocal-motor processes. Very rarely will one auditory complex, itself, suggest another.

The *Aufgabe* to recall auditory imagery and subsequently to describe it resulted, in this experiment, in an attempt to isolate the qualities and pitches of the imagined sounds from their visual accompaniments but inevitably the visual process which accompanies every auditory image claimed the focus of *A's* attention. It turned out that efforts to attend to the auditory qualities themselves resulted in a diminishing of the clearness of the visual accompaniments, and in such instances *A's* attention shifted to the muscular elements of attending rather than to the auditory qualities *per se*. Thus it seems that in attending to sounds as such (and the same is true of attempts to attend to any sensory process other than the visual) one of two things inevitably results: either the effort is shunted into motor channels or the effort results in a shift to the visual accompaniment. If the effort results in a dominance of muscular features the visual features of the experience at once tend to fade. Consequently at times in *A's* introspections there appears not only a meager description of the auditory qualities but also of the visual. We believe that the reason for this is to be found in the fact that observer *A* can describe auditory qualities only in terms of visual qualities and hence, when the latter are non-focal, it is impossible to identify the auditory qualities themselves. In this fashion efforts to isolate the auditory qualities as such render it difficult to observe the accompanying visual imagery. The effort thus defeats itself.

The colors which are associated with auditory imagery are invariably identical with those colors which accompany corresponding auditory perceptions. The former colors, however, may be less vivid, more fleeting, less saturated or less bright than the colors which accompany the analogous perceptual processes. Obviously this state of affairs is due to the fact that auditory images are less stable and are ordinarily, in themselves, less clear and definite as regards qualitative detail than are the corresponding perceptual experiences. On the other hand his introspections on auditory imagery have shown that the visual accompaniments may become detached from their parent processes, the auditory images, and may appear alone in prolonged trains or successions. In this fashion there may appear in *A's* consciousness successions of colors or degrees of brightness which stand for remembrances of successions or of combinations of tones. This state of affairs is most likely to

occur as a result of an *Aufgabe* to recall auditory imagery which has apparently decayed beyond the possibility of easy arousal, and shows that the visual associates of auditory images appear more readily than do the auditory images themselves. *A* frequently experiences this situation in every day life, particularly in trying to recall names of persons. The color which symbolizes a certain name may appear detached from its parent process and no amount of effort will result in recalling the name itself.

Observer B. Auditory imagery plays a very important rôle in all of *B's* higher mental processes, although, as we shall discover later, it is less important than cutaneous or kinaesthetic imagery. Prominent features of his auditory imagery consist of its clearness, intensity, wealth of qualitative detail, wideness of range and variety, readiness of voluntary control, but of relative lack of persistence and lack of exact faithfulness to the delicate qualitative features of his auditory perceptions. As in the case of his visual imagery *B* finds himself tending to translate auditory imagery into kinaesthetic processes. If it is his own voice or another person's voice, a tune or melody played upon a musical instrument which is the subject matter of this auditory imagery, kinaesthetic processes invariably constitute a setting or background, and here this setting is usually vocal-motor or manual-motor imagery. For example, while *B* was experiencing auditory imagery of a violin he was aware of manual-motor imagery of playing the instrument.

iii. Auditory imagery of A and B compared.

1. *B's* auditory imagery far exceeds *A's* in all matters of attribute and behavior.

2. In contrast to *B's* kinaesthetic background, *A's* settings for auditory imagery are largely visual with now and then a vocal-motor accompaniment.

3. Both observers agreed that auditory imagery was more stable when accompanied by other forms of imagery. Moreover, the presence of a background or setting was definitely correlated, in both observers, with wealth of quality and variety of range in the auditory imagery.

4. Both reagents resorted to other types of imagery other than the auditory in a voluntary attempt to control the auditory

images themselves. Both reagents had recourse to vocal-motor imagery but in *A's* case this method proved to be a disadvantage for the reason that it resulted in arousing extra visual imagery which dominated consciousness to the exclusion of the desired auditory-visual imagery.

5. *A* is synaesthetic with respect to auditory imagery. *B* is not.

iv. Significance of A's synaesthetic processes in the field of auditory imagery.

The following considerations point to the similarity of synaesthetic phenomena and synaesthesia proper in the field of audition. In both instances the behavior and properties of the associated visual image depend upon the behavior and properties of the parent process as long as the latter is present in consciousness; in both instances the associated image appears to have the same function or value—that of identifying the parent process. (This observation we have made only in a general way so far. It remains to be determined whether this fact is invariably true.) On the other hand we have found a singular difference between synaesthetic phenomena and synaesthesia proper. In the latter the associated image seldom appears in the absence of the primary process while in the former the associated image may frequently appear without the primary image to which it is normally attached. Whenever the associated image thus appears detached and alone it symbolizes or stands for the primary image which is lacking.

It is evident that in the synaesthetic phenomena of *A's* field of audition the implied qualities and behavior of auditory images are described and identified in terms of their accompanying visual images, and that when *A* wishes to attend to auditory qualities as such he can do so only by way of a visual "route." This, in our estimation, can signify only one thing, namely, that the act of becoming conscious of auditory qualities in *A's* case demands a visual image. This means that in order to "cognize" an auditory image —for that is what is implied by becoming conscious *of* an auditory image as such—a certain behavior of attention is necessary or a certain and very greatly attenuated process of recognizing is implied. In the process of recalling definite and particular auditory images the asynaesthetic subject evidently uses "old" auditory imagery itself or else secondary factors, such as are involved in the act of perceiving a sound. Our synaesthetic subject employs

visual imagery instead. But this is not an extraneous or unnecessary habit which observer *A* has developed. It so happens that *A* cannot become conscious *of* an auditory image in the absence of its identifyer, the visual image, any more than can an asynaesthetic person become aware of a flute tone, for example, either without a definite standing-out of a characteristic woody or punky, hollow-like quality or without some secondary criterion such as visual imagery of a flute, someone playing a flute, or such as the verbal image, "flute." *A's* visual synaesthetic images are *criteria* of his auditory images. They are not vicarious processes. *A* is able to visualize a flute; he can say the word "flute." He has auditory imagery of flutes. The problem is simply this: an asynaesthetic person must have *other processes* aside from a bare, raw, or isolated and indescribable quality of tone before that tone, even in terms of imagery, can become a *flute* tone. *A's* mental life offers no exception to this general rule. *A's* synaesthetic images, so-called, constitute these *other processes.* In other words his visual associates of auditory images lend *meaning to the auditory imagery itself.*

c. Tactual imagery. (Series 1 continued.)

i. Typical introspective data.

[Instructions: Recall tactual imagery of roses lying in a box and backed by ferns.]

25. *Observer A.* "As the experimenter said 'roses' I was aware of momentary tactual imagery of the feel of the buds, localized at the tips of my fingers and in the palm of my right hand; no sooner had this imagery appeared, however, when my attention shifted very suddenly to a group of tiny blocks of faint light. This latter imagery was not visual imagery of the rose buds themselves but consisted of visual synaesthetic processes which always accompany this quality of pressure. I then revived this tactual imagery, the exact details of which I had not observed previously, and detected the spongy-like softness of the sides of the buds, and this imagery, like the first, was not only localized at my finger tips and palm but was accompanied by and tended to shift into visual imagery. In every instance the visual synaesthetic processes persisted longer than did the tactual qualities. Then, as the experimenter said 'ferns' I had fleeting tactual imagery of ferns pressing against the ends of my fingers, together with imagery of coldness; the coldness quality dominated and at once the entire experience developed into a visualized, synaesthetic cold. As before my attention shifted in the direction of visual from the tactual processes. I was then aware of the closer edge of a box, in terms, first of tactual imagery localized on the under side of my wrist as if the box were pressing against my wrist while my hand might have been extended over into the box itself. Again this imagery at once turned to visual imagery. Then there returned tactual imagery of ferns localized on the inside of my thumb and index finger as if I were holding a fern in my hand, but at this juncture the tactual imagery, the qualities of which at no time stood out focally in consciousness, as such, suddenly gave way to visual imagery of tiny bars of light; these resembled in brightness and in behavior the sparkles from a large diamond and meant to me the roughness of the tactual imagery. I forgot to mention

that the color which appeared in connection with the image of coldness was the usual bright silvery light which always means coldness. It was coldness which dominated in the first tactual imagery of the ferns; now it was the roughness of the ferns. All during this time I was dimly conscious of persisting colored forms, characteristic of the experimenter's voice; these colors were suspended in space in the left margin of my visual field—the region nearest the experimenter. I should have mentioned also that the dim white light associated with the pressure of the rosebuds was localized at my fingertips and palm, as was the tactual imagery itself; the tiny bars of light which appeared in connection with the roughness of the ferns and the white silvery area which appeared in connection with the coldness of the ferns were likewise localized on my right hand. The size of the visual image corresponded to the area of the tactual image in each case. The tactual imagery appeared suddenly throughout, as if momentarily suggested by the experimenter's words; but it disappeared equally as suddenly. At no time was I conscious of kinaesthetic imagery of handling the buds or of such imagery as picking up the box or its contents. Neither did I have tactual imagery of the tips of the buds or of the prick or sharp pressure of the thorns. This imagery I can recall, now, but I was not aware of it immediately following your instructions."

[Further instructions: You mentioned seeing the colors which stood for the experimenter's voice. Can you describe the behavior of your attention with respect to these colors?]

26. *Observer A.* "During the experiment just performed I at no time attended strictly to the qualities of the experimenter's voice as he read the instructions. My attention was centered upon the meaning of the words as it seemed to issue from the resulting imagery which at once appeared and which I have just described in the preceding introspection. Rather than being aware, nonfocally, of the sounds of the experimenter's voice, I was nonfocally conscious of the accompanying colors. The colors and not the sounds were in the 'background' of my consciousness while I was experiencing the tactual-visual imagery. (Perhaps I can make this clear by an analogy. Suppose you were looking down into a valley, but with your attention focussed upon a house in the foreground. You would then be aware only non-focally of the hills in the background. In similar fashion visual imagery of the experimenter's voice was present but was in the margin of attention as well as in the margin of my visual field and it was not attended to, focally, at any time during the experiment. It lacked definiteness and I noticed no details in the imagery; I was aware only of its general features and of its presence. The fact which I noted about the experience consisted of the relative position of the imagery in my visual field and that this position was in a direction toward the experimenter himself."

[Further instructions: Can you describe the behavior of your attention with respect to the presence together in consciousness of your tactual and visual imagery of the rose buds and ferns?]

27. *Observer A.* " One instant I was aware of tactual qualities but in this awareness there stands out no definite or detailed item or characteristic of that quality. It is merely inferred tactual quality. The tactual imagery persists in this vague, undifferentiated fashion only long enough for my attention to shift to visual qualities. Thus the shift of attention, in this case, was almost instantaneous, but not quite; (I am doing this now, as I introspect) I am able to concentrate attention upon an effort to prolong this tactual imagery in which case I find that my method has consisted of resorting to kinaesthetic processes of handling the buds and ferns. But no sooner does this kinaesthetic imagery appear when my attention is claimed by the visual associates of the kinaesthetic imagery. (Suppose, for example, that I am making the movement of inspecting the heel of my shoe. I first obtain kinaesthetic imagery of reaching down toward my foot but the kinaesthetic quality at once gives way, during a rapid shift of attention, to the blackish streaks which accompany the motor imagery.

And if I attempt to single out the kinaesthetic quality as such or the tactual qualities as such, the visual associates become indistinct and tend to disappear altogether. I am able, I have often observed, to attend to both the primary and the secondary processes at the same time but only for the smallest fraction of a second and with the result that both processes tend to lose their identity. Unless I am prepared, by the proper *Aufgabe*, to attend to both, my attention always shifts *at once* toward the visual process the instant the primary process appears. Chronologicaly, then, the primary process, under the proper *Aufgabe*, does appear first, but so long as it persists it is vague, undifferentiated and absolutely impossible to describe other than by the term 'something.' "*

28. *Observer B.* Instructions as for introspection 25. " I was able at once to feel the softness of the petals, their smoothness, their fineness of texture, all of which features were localized, in tactual terms, at my finger tips. The imagery was exceedingly clear and real; at times I almost thought that I was getting real sensations; I was surprised at the vividness and persistence of this imagery and at its minuteness of detail; and this awareness, together with kinaesthetic imagery of moving my fingers about over the buds, made it almost impossible for me to keep my fingers still. Shifting from one detail to another with no loss in vividness and with continued nicety of quality my attention went from the edges of the petals as they curl over, to the pairs of petals as one extended slightly beyond the other but remained very close to it, then to the masses of petals in the center of the bud. There then followed equally as vivid and detailed tactual imagery of the ferns, of the edges of the rose leaves, of the flat surfaces of the leaves, and of the edges and smooth sides of the box. This latter imagery is of strikingly different quality, however, from my other tactual imagery. While I had, in tactual terms, the sharpness of the edge of the box and the glassiness or fine smoothness of the sides of the box, there is definitely present in this latter imagery a hardness which does not characterize my imagery of the buds and ferns. This quality of hardness does not seem to be entirely tactual, although I was not at the time distinctly aware of any other definite sensory qualities. I believe, however, that with this tactual imagery of the box there appeared, disguised as hardness, some kinaesthetic factors of resistance. The tactual imagery of the roses possessed the softness of silk; the smoothness of the ferns resembled the velvety smoothness of thick, heavy velour; the smoothness of the box suggested a glassy, almost slippery surface and was characterized by the firmness or resistance of a hard object. There was no setting in connection with this tactual imagery other than the kinaesthetic imagery which I mentioned. But this latter was mingled throughout with the tactual."

[Instructions: Obtain tactual imagery of the word "dog" written in American Braille.]

29. *Observer A.* "(I can readily construct this tactual imagery but not without recourse, first, to my visual kinaesthetic imagery of the letters 'd', 'o', and 'g.' I have not used American Braille for two years.)

Following my awareness of the instructions I found myself visualizing the letters of the word 'dog' in their appropriate colors. There first appeared visual imagery of the 'd,' then of the 'g,' followed by the 'o;' this imagery consisted of small areas of color localized off in space a short distance from me—a bluish-grey-green for the 'd,' a dusty-grey-green for the 'g,' and a dark, smudgy grey for the 'o.' (I believe that my attention shifted from the 'd' to the 'g,' skipping the 'o' for the reason that the two colors are very similar.) After this imagery had once appeared it shifted its position to a region nearer

*In certain introspections there exists an apparent confusion in terminology when observer *A* speaks of tactual, kinaesthetic, or auditory imagery as if it were, as such, present to his consciousness. It has been necessary to retain this terminology for clearness in meaning, but it should be understood that, throughout, the reagent refers to an undifferentiated and indescribable process as far as tactual or auditory qualities themselves are concerned. A consciousness of auditory or tactual imagery is an interpretation dependent upon the functioning of the accompanying visual process.

me as I began to have faint kinaesthetic imagery of moving my finger upward along the surface of a piece of tag-board and over what might have been some imagined points. At this juncture the visual imagery began to shape itself into the general forms or figures which would be made by the arrangement of the points of the Braille letters 'd,' 'o,' and 'g.' Even up to this time I was unable to obtain tactual imagery of the Braille letters; the imagery so far constituted my efforts in this direction. I then had kinaesthetic imagery of moving my finger along an imagined (visual) tag-board toward these visualized forms which were now projected upon the yellow, visualized paper. I then momentarily became aware of tactual imagery of the 'd.' This awareness did not consist of individual pressures from the points which constitute a Braille 'd' but of a generalized awareness of their triangular spacial arrangement. Even this awarenes of a triangular shaped form is an interpretation largely from the fact that in this tactual image my attention is centered not upon the three sides of a triangle but upon the position in the spacial figures where a point is missing, which point, were it present, would form a square with the other three points. This tactual image was localized at the tip of my right fore-finger and was regular 'Braille' size; and for a moment, I believe, I was conscious of the more or less punctiform but yet blunt character of the imagery, although at no time were the individual points recognized as such. At the moment my attention was centered upon the missing point the tactual image, itself, involved spacial extent but this spacial feature was not present to consciousness as such but was interpreted in terms of a sudden and subsequent shift of attention to a visualization of this space in the form of a triangle. Through all of this the colored visual imagery which had previously meant to me that I was trying to obtain tactual imagery of the 'd' persisted and at this juncture of my procedure it was this visualized 'd' which assumed the triangular shape. My tactual images of the 'o' and of the 'g' were less distinct for here the visual features of the experience claimed attention throughout; there were no shifts to tactual qualities as occurred in connection with the 'd'. In each case I had visual imagery of these letters localized as was the visual imagery of the 'd'; the 'g' was fairly definite with respect to color and localization; the points of the 'g' stood out as pane-like sections of light grey-green. What would correspond to the sash of this window-like figure consisted of tiny bands of neutral grey; the whole visual image was projected upon a neutral grey background. (By this time the yellow tag-board had disappeared.) My attention was then claimed by the visual imagery of the 'o' which now definitized into a short oblique line, colored, and slanting in the direction of the points which form the Braille 'o.' The upper portion of this oblique line, which corresponded to the upper point of the Braille letter, tended to take on the yellow of the tag-board, which now tended to become visualized; the lower section of this oblique line was dark, smudgy and almost black—my synaesthesia for 'o'. Then I found my visual attention wandering from these letters to the visual background of neutral grey. All of the imagery which I have just described was very fleeting and appeared with lightning-like rapidity, although, throughout the entire experience, the qualities or hues of the letters persisted. As my attention shifted during the latter part of the experience to the visual background, the individual colors which stood for the letters disappeared and there was left only a vaguely visualized section of a piece of tag-board. The area thus occupied by the letters now contained only the yellowish-grey of the paper upon which I had been projecting the letters themselves."

30. *Observer B.* Same instructions. "As soon as I perceived the instructions I at once had a mass of tactual and kinaesthetic imagery of the letters, of arm and finger movement and of the paper on which the points were punched. There first appeared tactual imagery of smooth tag-board together with kinaesthetic imagery of moving my finger from left to right along the surface of this paper as if I were about to approach a Braille letter. I was then conscious of very vivid and intense tactual imagery, blunt and yet limited

almost to a point, of the first dot of the letter 'd'; this image was localized rather at the side of my finger than at the very tip just as the actual sensation would have been perceived had I come upon the point with actual finger movement. This was immediately followed by equally as vivid and definitely localized tactual imagery of the remaining points of the 'd'. For a brief instant, in this latter imagery, the individual points did not stand out, but they soon became definitized and arranged in the characteristic grouping of the 'd.' In the tactual image itself I found that my attention, however, was not focussed upon the pressure qualities nor upon the triangular shape of the spacial arrangement of points but upon that region in the figure where a fourth dot would be if the figure were a square. [Notice that Observer *A* reported the same experience in introspection 29.] There then occurred kinaesthetic imagery of moving my finger to the right in the direction of what would have been the next letter of the word 'dog' had I been obtaining the word in perceptual fashion. This was closely followed by tactual imagery first of the right hand point of the 'o' and secondly of both points; at this juncture the two points appeared in their proper spacial relations, forming an oblique line extending downward from left to right. Tactual imagery of the 'g' followed immediately in similar fashion except that the behavior of my attention differed slightly. The imagery itself was as clear and as definitely localized as was the former imagery, but as I had kinaesthetic imagery of moving toward the right I obtained tactual imagery of not one point alone, as before, but of two points, and these points appeared spacially grouped as they were being imagined. Here I was not aware of the pressure qualities as such but of the spacial grouping as such. That is, I imagined them as a bar, not as two points. Following immediately upon this and so rapidly that the two experiences were almost simultaneous, the bar thus imaged developed into a tactual square. Here, again, it was the spacial arrangement of the points and not the distinct and separated points themselves which stood out in focal attention. Yet the entire imagery possessed as much clearness and definiteness of localization at the end of my finger as did the previous imagery in which the points stood out for a time as separate bluntnesses. All of this happened very quickly and had no sooner taken place than I found myself tending toward incipient movements, localized in the arms and shoulders, of making large, sweeping motions as if I were about to draw enlarged letters of solid lines instead of making these letters of points. I noticed that my tactual imagery developed very suddenly to a high degree of focality and that it shifted exceedingly rapidly from one detail to another with no perceptible break in between. As one detail in the tactual imagery gained clearness the shift was so rapid to the next detail that I noticed no perceptible diminishing in clearness of the preceding detail before I was focally conscious of the succeeding detail. Each letter was accompanied by incipient vocal-motor tendencies to pronounce it."

ii. Summary of introspective data on tactual imagery.

Observer A. A study of *A's* descriptions of his tactual imagery would lead one to conclude that his ability to image the "feel" of objects is as limited as we found his ability to image sounds. Tactual qualities themselves are vague and undifferentiated as was his auditory imagery. Tactual imagery is fleeting, disconnected, rather lacking in detail and unstable. Every detail has its visual counterpart in synaesthetic imagery and every tactual image at once gives way to this visual accompaniment. The same shift of attention from tactual to visual qualities appears in his

tactual imagery as took place from auditory to visual qualities in his auditory imagery. Thus, like his auditory imagery, his tactual processes are broken into disconnected series by repeated shifts to the visual accompaniments even when tactual imagery itself appears in relatively prolonged series.

As was the case in auditory imagery, *A's* attention does not shift from one tactual quality directly to another tactual quality but from a tactual to a visual image and then back to a tactual image again. Only by voluntary effort which involves kinaesthetic imagery and incipient muscular movement is *A* able to inhibit this tendency to shift from a tactual to a visual quality whenever a tactual image appears in consciousness. But under these circumstances, attention never lingers focally upon tactual qualities as such but at once shifts to the kinaesthesis of attention and hence over into visual processes again. In other words we find a duplication of the situation which obtained for auditory imagery, namely, that a tactual image as such is never the object of focalized attention.

As with his auditory imagery, visual associates persist longer in consciousness than do the combined tactual and visual processes. It is not uncommon that a tactual image itself is ushered into consciousness by means of its visual associate. The *Aufgabe* to recall tactual imagery results at first in the arousal of combined tactual and visual complexes but if the process of fulfilling the instructions be prolonged all tactual qualities tend to disappear with the result that the detached visual symbols represent the tactual qualities in the absence of the latter. We found the same to be true in his auditory imagery.

If a tactual complex such as a combination of pressure and cold was being experienced in terms of imagery the dominating feature in the complex determined the resulting color or brightness. Thus when observer *A* had tactual imagery of both the pressure and the coldness of the ferns in introspection 25, it was the coldness which dominated in the complex and which determined the synaesthetic image. Tactual and kinaesthetic blends, such as roughness, wetness, dryness and the like, have peculiar synaesthetic associates of their own. For example, in introspection 25, *A* described his visual imagery of roughness as darting rays or bands of light which resembled in size and behavior what might have been sparkles from a very large diamond.

Observer B. B's tactual images are exceedingly clear, persistent and real. In their quality and vividness they often closely approximate actual sensations. Other prominent features of his tactual images consist of their wealth of qualitative detail, exactness of localization, the readiness with which long trains or successions of this imagery are aroused and the exceeding rapidity with which attention shifts from one focal detail to another with no apparent loss in clearness, the clarity with which spacial extents stand out in this imagery, and the distinctness with which qualities retain their identity in complex groupings. The *Aufgabe* to recall tactual imagery of objects gives rise at once to complex groupings and successions of tactual images, together with kinaesthetic imagery and incipient muscular movements of handling the objects thus imaged in tactual fashion. Tactual imagery, then, appears in a rich, kinaesthetic setting. It is evident that one tactual image readily leads to another, with no apparent break in continuity of tactual qualities. It is interesting to note that tactual images, themselves, develop much as tactual perceptions develop. As a tactual image begins to run its course there may first appear but one detail or one isolated feature of the object which is to be imaged whereupon further details at once appear, resulting in a full-fledged image which takes in not only the later elements to appear but also the earlier ones. Thus his imagery of a Braille letter began with pressure images of but one point of the letter; this led immediately to imagery of additional points and to a subsequent arrangement of all the points into the appropriate spacial grouping. A clear and definite tactual image of a Braille letter includes the same behavior of attention as occurs in the perceiving of such a letter. When the image has developed to its final stage, individual points lose their identity; within the image they no longer stand out as separate points; attention ignores the individual blunt pressures and is concerned wholly with their spacial arrangement. Thus it would appear that if an image of a complex object is to be complete there takes place in the development of this image a shift from individual elements or ingredients to a fusion or synthesis of these elements, just as takes place in the development of a perception. This shift is equally as rapid and as difficult to describe in the imaginal field as in the perceptual field. This growth of a full-fledged image suggests that in the field of the so-called centrally aroused processes we find a difference between image and

idea which corresponds to the difference between sensation and perception in processes which are peripherally aroused. Let us call the individual elements—the separate bluntnesses—which go to make up a full-fledged tactual image of a Braille letter the image elements, and let us call the image in its final stage of development an idea of the Braille letter. Thus we have images corresponding to individual Braille points and a fusion or organization of these images into an idea which corresponds to the perception of the Braille letter as a whole. In the shift from image to idea there develops a spacialized grouping or arrangement of the points just as there develops, in the act of perceiving a Braille letter, this same grouping or arrangement of points. The criterion of an idea as offset against an image thus consists of the same sort of blending or fusing process as takes place in acts of perceiving. This behavior of attention in the development of a full-fledged image is but another way of describing the development of meaning in the image.

iii. Tactual imagery of A and B compared.

1. *B's* tactual imagery far exceeds *A's* in complexity of qualitative detail, clearness, intensity, range of variety, and in continuity of function in groups and successions.

2. There is observable in *B's* case a tendency for tactual imagery to give way ultimately to kinaesthetic processes, while in *A's* case tactual imagery gives way at once to visual imagery.

3. The setting for *B's* tactual processes is kinaesthetic; the setting for *A's* tactual imagery is visual. These settings vary in their function, however. *A's* visual imagery appears concomitantly with his tactual processes; it functions both in the focus and the fringe of consciousness while tactual processes are present. But in *B's* case kinaesthetic imagery is largely relegated to the background of consciousness, under the *Aufgabe* to recall tactual imagery; and in his case kinaesthetic processes do not function as identifyers or as labels for his tactual processes; the latter stand for themselves and occupy the focus of his attention, as such. Tactual imagery, as such, never occupies the focus of *A's* attention. In other words *B's* motor imagery does not "interpret" his tactual imagery and is not inevitably a concomitant of the latter while *A's* visual imagery "belongs" to the tactual and the visual tends to take the place of the tactual at all times and under all conditions.

While *B* is attending to tactual qualities, *A* is ignoring them, as such, and is attending to visual qualities. The quality of pressure, in *B's* tactual imagery, is a quality of pressure and nothing more. The quality of pressure in *A's* tactual imagery *is,* in part, *a visual image,* in that the pressure is not identified in the absence of the visual process. The essential difference between *A* and *B* lies in the act of becoming conscious of tactual imagery. *A* resorts to visual criteria while *B* resorts to tactual criteria.

4. There is a further difference between *A* and *B* as far as their tactual imagery is concerned. We have already described, on page 44, how tactual imagery develops or becomes full-fledged in *B's* case. This process of growth in *A's* case does not involve a grouping or arranging of identified bluntnesses or points which blend or fuse into a purely tactual, spacial extent. This grouping, in *A's* case, involves a dual growth of tactual and visual processes, with the reagent's attention focused upon the visual half of the experience. In other words, step by step, in the development of a tactual image there takes place a corresponding development in visual imagery and the latter throughout interpret or identify the developing stages of the former. Thus, as *A* was aware of the growing tactual image of the Braille *d* described in introspection 25, this awareness was always focally a visual consciousness. We found that in *B's* case the meaning of *d* developed with this blending or fusion of discrete points into a spacial schema and that the spacial schema was inherently and focally tactual, plus kinaesthetic imagery. The corresponding development of a meaningful *d* in *A's* case involved a growth of visual processes. The *d* was not complete until the bluish-green synaesthetic image had assumed the size and shape of the figure *d.* In *B's* case the meaning was tactual-kinaesthetic; in *A's* case it was tactual-visual.

5. These points of difference identify *B* as an asynaesthetic individual and *A* as a synaesthetic individual.

iv. Significance of synaesthetic imagery in A's tactual processes.

As a result of his synaesthetic processes *A* does not live in a world of tactual and motor phenomena as such. His tactual and motor world is *also visual.* It has now become evident that while tactual imagery is present in *A's* consciousness, this imagery possesses no distinct and concrete qualities or features *of its own.* The size and shape of tactual images are represented by a corresponding

size and shape in the visual accompaniment; for every implied tactual quality there is a corresponding hue or brightness in the visual associate; duration and intensity of tactual images have their visual counterparts in duration and brightness of the colored associate. The important feature of this synaesthetic process lies in the fact that a color or brightness is selected, in *A's* behavior of attention, as the feature of the experience which is attended-to rather than a tactual quality or attribute *per se.* Tactual imagery cannot stand alone in consciousness and *be tactual imagery.* As long as a tactual process is unaccompanied by a visual image the former is a diffuse, vague, and unidentified experience.

This suggests that all imagery, even in the asynaesthetic individual, undergoes an implicit process of identification if it is to become imagery of any given type, variety, or quality, or if it is to possess meaning. This implicit process of identification or recognition is very obscure and attenuated in the asynaesthetic individual and because of frequent repetition or because of the fact that the identified and the identifying processes take place so quickly in rapid succession or perhaps blend, the identification process is not always introspectively observable. But in the synaesthetic individual the process of identification is always explicit and observable because the identified process is derived from one sense modality and the identifying process from another sense modality. Thus when observer *B* has a tactual image of roughness, that quality, as such, stands out focally in consciousness; the experience is one *of roughness;* the identification or recognition implied by the "of" is actually implicit. The processes identified are pressure images; the identifying process consists of a peculiar behavior of attention characterized, perhaps, by a mass of rapid shiftings from one discrete tactual image of a certain clearness and intensity to an immediately adjacent tactual image of another clearness and intensity. But in *A's* case the experience is not one *of roughness* as observer *B* knows roughness; the qualtiy of roughness as such does not develop; the identification implied by the "of" is here explicit. The processes identified are pressure images as in the case of *B;* but the identifying process consists of a shift of attention not from one tactual image to another but from a tactual to a visual image. In implicit identification tactual processes in a way identify each other, in part, by means of attention shifts from one to another; in explicit identification the tactual

process is identified by a visual image. The functioning of the processes in both instances is the same but the mental contents involved differ radically.

We must not confuse this synaesthetic process with the visual imagery used by an asynaesthetic individual in attending to tactual imagery. An asynaesthetic person may tend to experience visual imagery when he experiences a localized tactual image but here the tactual features of the experience may occupy the focus of attention with the visual imagery entirely non-focal. The tactual feature remains dominant so long as the tactual imagery persists and the visualization of the region where the tactual imagery is projected always remains a secondary process. It may very well turn out that this secondary visual image assists, while it is present, in definitizing the region where the tactual image is projected but the visual image itself can hardly be said to identify the tactual process, as it does in the synaesthetic individual. The synaesthetic character of *A's* visual imagery exceeds a mere tendency to localize the tactual process, visually, for in addition to this tendency to visually localize the tactual image, the quality of the latter and in fact its entire behavior are visualized.

From *A's* field of tactual imagery we therefore obtain added evidence of the possible view that synaesthesis is not only a perceptual process but that it is an imaginal process as well; furthermore we find that synaesthesis is not different, functionally, from processes which occur in an asynaesthetic individual. Introspections on tactual imagery furnish supplementary evidence in favor of the conception that synaesthesis is essentially a process of deriving meaning from sensory data.

d. Kinaesthetic imagery. (Series 1 concluded.)

i. Typical introspective data.

[Instructions: Recall kinaesthetic imagery of tying your tie.]

31. *Observer A.* "(I found that I could obtain motor imagery of movements of my right arm but not of my left. All I could obtain of the latter were the detached visual associates.) As the experimenter read the instructions I was first aware of visual imagery of my collar, localized in its position around my neck, with the long end of a tie extending downward in front. Although the collar was white, no other feature or detail stood out prominently in the image other than its vague shape and its band-like form; the tie was a very dark grey tinged with brown. There then followed kinaesthetic imagery of my right arm making the movement of throwing the long end of the tie over the short end; for a moment only was this imagery clear; attention shifted almost at once to a black visual streak which took the form of a curve corresponding

to the extent and direction of the kinaesthetic image. Then I had motor imagery of reaching under the twisted portion of the tie with the long end, but before this imagery reached the stage of pushing the long end up through the knot the motor features had shifted entirely to the black, visual, synaesthetic imagery. There started to develop at this juncture vague tactual imagery of the softness of the tie as it seemed to rest between my thumb and fingers, but this, also, shifted immediately to its visual associate. There then occurred combined tactual and kinaesthetic imagery of reaching into the 'v' shaped knot from above, as if to grasp the long end of the tie to pull it through the loop. For an instant the kinaesthetic quality of movement loomed up in fairly focal attention, when I experienced the kinaesthetic image of pushing the long end of the tie through the knot and of pulling it tight. The motor quality which became momentarily dominant was the sudden jerk or pull of tightening the knot itself. Otherwise the kinaesthetic quality tended to be dominated by the visual black. And just as this motor jerk developed the visual synaesthetic accompaniment became blacker. I noticed that throughout the entire process this imagery was localized in my right arm and hand; I tried to attend to movements of my left arm, but had only the visual streaks which represented in terms of their own localizations and directions of movement how my left arm would operate in tying a tie. Kinaesthetic imagery was throughout broken into disconnected sections by repeated shifts of attention to the visual accompaniments. I further noticed that it was when I tried the hardest to isolate or single out the kinaesthetic quality of the imagery that the visual processes dominated most. The motor imagery was localized in my elbow, wrist, and finger joints. The chief quality of the imagery was that of change in position with strain appearing only when I imaged the pull or tug of tightening the knot."

[Instructions: Describe the maze which you have recently learned and recall the movements of tracing the paths.]

32. *Observer B.* "The maze was a grooved figure cut from a sheet of tin and tacked to a smooth board. I was aware, first, of tactual imagery of the stylus as it rested between my fingers with kinaesthetic imagery of grasping it; the kinaesthetic processes were the more definite and persistent and involved imagery of finger positions and tenseness about the wrist and arms. In terms of very clear kinaesthetic imagery I was able to recall practically every movement of tracing the maze; the imagery was always that of movement and was definitely localized in my hand, arm and wrist. I vividly felt the constantly changing positions, now down, now up, now around a sharp angle. Throughout, these changes occurred in rapid succession, one image blending imperceptibly into the next; the imagery was very stable, clear, and persistent, with no breaks or interruptions. At the end of the maze I had very vivid motor imagery of the resistance encountered as the stylus came into imagined contact with the termination of the pathway. This latter imagery developed suddenly and rose to a high degree of focality, just as the actual perception would have done. Although there were sounds made in actually tracing the maze, I had no suggestion of auditory imagery in this recall. Consciousness was occupied almost entirely with motor processes with only now and then a suggestion of tactual imagery."

[Instructions: Can you recall motor imagery of the maze which you learned three years ago?]

33. *Observer A.* "(After some little time, during which I was visualizing a very vague and fleeting maze, I think I succeeded in recalling a few isolated movements.) First I was aware of kinaesthetic imagery of holding my arm out in front of me, together with tactual-motor-visual imagery of holding a stylus in my hand, but all of this was very vague and of short duration. Attention was then absorbed for several seconds in vague, varying, and fleeting visual imagery of portions of the maze. There then appeared in consciousness a

motor-visual image of making one of the long and difficult movements in the maze, but the motor qualities were very weak, diffuse and vague, dominated almost entirely by the accompanying visual black which appeared as a developing streak over a fairly wide space in front of me and in about the same position as the maze would have been. I then recalled that I had great difficulty in learning this movement for the reason that I had to come down a straight path toward me and I had the tendency to make that movement in the form of an arc, thus making a great many errors. The motor features of this kinaesthetic image were localized in my shoulder, elbow and wrist and slightly in the muscles of the fore-arm. The former possessed the quality of movement while the latter qualities suggested strain or tension. Together with this imagery I was aware of incipient tensions developing about the jaws and in my throat—the processes which always appeared when I was conscious of making a great many errors while tracing the maze. The usual blackness of the kinaesthetic processes appeared and tended to claim my attention. The tenseness in my throat, jaw, and somewhat in my chest, was accompanied by black visual imagery localized as was the kinaesthetic imagery itself. The localization of the motor qualities, however, was invariably less definite than the localization of the visual black. There was a diffuseness, vagueness and uncertainty about the motor processes which seems to be compensated for by the visual associates."

[Instructions: Recall writing with the point alphabet and describe the imagery involved.]

34. *Observer B.* "First I had tactual imagery of the slate beneath my hand, vague auditory imagery of the sound from the stylus as it punched holes in the paper, and very clear, definite and persistent kinaesthetic imagery of making the movements of hand and fingers as one punches holes in the tagboard; the auditory and tactual imagery was much less clear and real than the kinaesthetic. Clearest of all in the motor imagery were the movements of pressing down on the stylus and of moving my hand along to the next position from which the next hole is to be punched. All of this kinaesthetic imagery was accompanied by incipient movements; in fact the reality of the motor imagery seemed to be proportional to the amount of incipient movement involved or to the extent that I actually felt incipient tensions. These processes were followed by very vivid and persisting kinaesthetic imagery of lifting the slate and of placing it in a lower position on the paper; this latter imagery involved hand, elbow and shoulder. Just as I imaged myself lifting the plate in terms of motor imagery, I had faint tactual imagery of the slate between my fingers, attention, in this latter imgery, being centered upon the perforations in the slate."

[Instructions: Recall the movements of throwing a ball. Describe them.]

35. *Observer A.* "(I can do this only by standing up and assuming a position as if I were about to throw a ball. Otherwise my motor imagery resolves itself into nothing but the visual associates.) I then had, first, a visual image of a baseball in my hand, both the ball and the hand standing out clearly in this imagery and localized in the beginning stage of the throwing position. This was followed by tactual imagery of the ball, chiefly localized between my thumb and first two fingers. The first real kinaesthetic image was that of swinging my arm back into position to thrust the ball forward; this was localized in my elbow and shoulder, principally the latter; there then followed motor imagery of tightening the biceps, very definitely localized for an instant in my biceps and followed at once by a shift of attention to the intense black region in the upper arm—my synaesthetic image. Then I found my attention claimed by a mass of black visual imagery covering my chest, back and sides, but I was unable to isolate the kinaesthetic elements. This meant to me, however, motor imagery of making the final contractions before letting the ball go. I could not obtain kinaesthetic imagery of releasing the ball but was conscious of very fleeting and sketchy tactual imagery of the ball as it was leaving my hand."

36. *Observer B.* Same instructions. "First I had very clear and intense tactual imagery of the ball lying in my hand, loosely grasped. Then followed in very rapid succession, in terms of kinaesthetic imagery, tightening my grasp upon the ball, drawing my arm back, swinging my whole arm around once or twice and then thrusting it forward suddenly as if to release the ball. Most vivid of all was imagery of the slipping or grinding at the shoulder joints and the quick thrust of the forward jerk of my arm. The finger movements of releasing the ball also stood out very prominently. All of this was followed by imagery of muscular tenseness localized in my neck and chest of anticipating the sound of the ball striking against the mit of the person who, by implication, was to catch the ball. Along with these processes there appeared fleeting and dim vocal-motor-auditory imagery, in terms of my own voice: 'Will he catch it?' in rising inflection. This imagery on the whole was so real that I found myself inhibiting actual movements. All of the imagery was accompanied by incipient movements or tensions."

[Instructions: Recall imagery of playing the piano.]

37. *Observer B.* "First, I was aware of tactual imagery of piano keys beneath my fingers but this was accompanied by motor imagery of placing my fingers against the keys and the latter very soon dominated consciousness; there followed very real and intense motor imagery of finger movement as if I were searching for certain keys; particularly clear were the imaged movements at the finger and wrist joints. The quality was that of changing position rather than that of tension or strain. Then I had tactual-motor imagery of playing the first one or two measures of the 'Waltz Caprice', together with auditory imagery of the first few bars but this latter was indistinct, compared with the motor processes. In rapid succession I imaged the positions and movements of my fingers, also the movements of elbow and shoulder as I shifted from one part of the keyboard to another and as I approached the keys with greater or less muscular energy. I was then conscious of sensory tension concerned with the process of anticipating hitting the wrong key as I imaged a sudden and extended movement of my left hand far down the key-board; this latter imagery involved not only wrist and arm but movement of shoulder and back as I shifted my imaginary sitting position in order to reach far enough down the key-board. Together with these latter processes I was conscious of incipient tongue and lip movements which I always have while playing a difficult selection. The imagery was characterized by its persistence, wealth of quality and by its continuity."

[Instructions: Recall the movements of tying a fisherman's knot.]

37a. *Observer A.* "(This is a motor complex which I have not performed for at least five years.) The first processes of which I was conscious consisted of two black visual synaesthetic images of movement in the form of two half circles. Up to this time I noticed that I was in a general state of bodily relaxation so far as incipient tendencies toward movement or tension were concerned; that is, I noted no tendencies to make the incipient movements of tying the knot or of figuring out how such a knot should be tied. Up to this time, also, I was unable to differentiate any real kinaesthetic qualities associated with the black visual images. I then set up for myself the task of making slight movements more or less at random, at first, of tying such a knot. I was then able to recall some of the movements in terms of kinaesthetic plus the visual accompaniments. Here the kinaesthetic qualities of motion and change of finger and arm position appeared in fleeting fashion. (This experiment confirms my observations in general that if I wish to recall old muscular movements, kinaesthetic imagery does not appear until I am able to make the proper incipient and actual movements. These latter seem to set off the old kinaesthetic-visual trains of imagery which could not at first be recalled. Otherwise,

without these incipient movements, I can only recall the visual imagery ordinarily associated with the kinaesthetic images themselves. Thus, when I am relaxed or not tending to assume an active bodily or motor attitude toward the task in question, I am much more apt to recall merely the visual black of my kinaesthetic imagery; while if I assume an active attitude, involving incipient movement, I am able to revive the kinaesthetic-visual complex.)"

ii. Summary of introspective data on kinaesthetic imagery.

Observer A. Characteristics of *A's* kinaesthetic imagery may be summarized as follows: The imagery as such is invariably vague, fleeting, difficult of description, patchy, disconnected and very difficult to recall; memories of old and decayed kinaesthetic complexes appear first in terms of detached visual associates; while it appears frequently in *A's* consciousness and is used generally in his imaginal processes in connection with objects or movements recently figuring in his everyday life, this imagery is not attended-to focally; kinaesthetic qualities do not usually stand alone in consciousness but lead at once to stereotyped forms of visual associates; the visual associates of his motor imagery are always very dark or black, the intensity of which corresponds to the intensity of the kinaesthetic feature of the image; these visual associates appear in the form of streaks, bands, or ribbons, when representing movement, and these streaks or bands define the extent, position and direction of the movement itself; the presence of this visual imagery makes it impossible for *A* to obtain unbroken or continuous successions of kinaesthetic imagery as such, for the visual accompaniments intrude upon the continuity of this vague and undifferentiated kinaesthetic consciousness.

The result of voluntary effort to attend to kinaesthetic qualities as such is either a tendency to become absorbed in incipient muscular movement with visual accompaniments immediately rising into the foreground of consciousness, or a tendency to shift directly to the visual associate of the kinaesthetic imagery itself. This dilemma makes it almost impossible for observer *A* to examine kinaesthetic qualities as such. We have found this to be true of his auditory and tactual imagery. When he endeavors to concentrate on sensory qualities other than the visual it always seems as if these qualities were "one step behind attention" while the visual process always seems to be "with attention." Thus qualities other than the visual are always marginal or non-focal; they never become objects of "direct" attention.

Kinaesthetic imagery reveals the same tendency ultimately to give way entirely to visual associates, leaving the latter detached, as was found in connection with tactual and auditory imagery. For example, when *A* recalled motor imagery of throwing a ball during the first few seconds of the recall kinaesthetic imagery appeared together with its visual accompaniment but shortly the kinaesthetic imagery dropped out and the remainder of the imagery of throwing a ball was finished in terms of the visual black synaesthetic imagery, alone.

Noteworthy is the fact that when *A* is relaxed or when he does not tend to make incipient movements, visual synaesthetic images are apt to appear at the outset, alone, as symbols for the motor imagery. On the other hand, if *A* assumes an active motor attitude toward the task kinaesthetic imagery, plus the visual associate, will appear.

There is to be noticed a slight difference between kinaesthetic and other types of imagery in the suddenness with which they lead to their synaesthetic counterpart, as they appear in consciousness. If kinaesthetic imagery leads to incipient movement or is accompanied by incipient movement in any given kinaesthetic complex, *A* then becomes more definitely conscious of kinaesthetic qualities as such and is able to describe them more or less vaguely and indefinitely. For this reason, motor imagery possesses the qualities of movement, and at times, of strain. But in such instances in which kinaesthetic imagery is thus rendered more focal or identifiable by incipient movement, the incipient movement itself ushers into consciousness visual synaesthetic imagery which latter assists in defining the motor qualities. Continuity of kinaesthetic qualities as such is confined to this shift from kinaesthetic imagery to kinaesthetic sensation but since the two tend to appear together and since the kinaesthetic sensation at once leads to a visual image, this continuity is never much more prolonged than it would be in the absence of the incipient movement.

Observer B. Kinaesthetic imagery is by far the type which appears most often and whose qualities are most vivid and persistent. It forms the background of *B's* visual, auditory and tactual imagery. Incipient movement functions as the background or setting for kinaesthetic imagery. So real are his motor images that he often finds himself inhibiting actual movement when the former are present in consciousness. Long trains or successions

of motor images occur without interruption or without intervention by images from another modality. *B's* consciousness is never free from kinaesthetic imagery of some sort; and this imagery is the common tool or vehicle which he uses in mediating or controlling imagery from other sense modalities. In fact the very existence of visual imagery in *B's* consciousness seems to depend upon motor factors.

Practically all qualities of kinaesthetic imagery are equally distinct and focal; change of position, rate or speed of movement, strain, jerky, rapid jolts, tenseness—all occupy focal attention at one instant or another in his kinaesthetic-imaginal consciousness. These qualities, however, are invariably reported to be more vivid when accompanied by incipient movement or tension. In fact it was so difficult for *B* to differentiate motor imagery from incipient movement, at times, that we are uncertain where one ends and where the other begins. This fact holds generally, we believe, for kinaesthetic image and sensation.

iii. Kinaesthetic imagery of A and B compared.

1. Both observers agree that kinaesthetic imagery is more stable, more definite and qualitatively more rich in detail when accompanied by or fused with incipient movement.

2. *B's* kinaesthetic imagery far exceeds *A's* in all matters of attribute, and in complexity of implicit behavior.

3. *B's* kinaesthetic imagery functions as a general setting or background for all of his other types of imagery but in doing so the kinaesthetic processes are not claimants of his focal attention until imagery of other modalities gives out. *A's* kinaesthetic imagery does not function as a general background or conscious setting. His settings are always dominantly visual and visually synaesthetic, and the visual synaesthetic imagery is always the claimant of his focal attention to the exclusion of all other modalities.

4. In voluntarily controlling their imagery each observer uses the one type which possesses the greatest wealth of detail or which appears in elaborate groupings or successions. This type is kinaesthetic in *B's* case and visual in *A's* case. It seems that it is the type of imagery which functions as a setting or background of consciousness which is employed in an effort to usher into consciousness or to prolong imagery of other types. For example *A* habitually uses his visual synaesthetic imagery in recalling auditory, tactual and kinaesthetic imagery; a detached visual associate

of a certain tone will suggest auditory imagery of that tone; visual imagery of letters will suggest tactual imagery of letters. The one exception to this procedure is *A's* use of incipient muscular movement in voluntarily controlling his kinaesthetic imagery. *B* habitually employs kinaesthetic imagery in an effort to recall or to control visual imagery; he prolongs his tactual imagery by having recourse to kinaesthetic processes; or he uses vocal-motor imagery in recalling auditory imagery. It is quite evident that the form of imagery which, in each reagent, possesses the greatest amount of qualitative detail and which has come to appear and persist in consciousness most readily, is that type which is not only controlled or mediated with least difficulty but is the type which is used as clues in the voluntary control of other types.

5. One striking difference is to be noted between the functioning of *A's* synaesthetic processes and *B's* kinaesthetic background. The former remain focal as well as marginal as long as they are present in consciousness while the latter remain only marginal as long as other types of imagery tend to claim the focus of attention.

B. Series 2*. Early and Recent Memories.

a. Early memories.

i. Typical introspective data.

[Instructions: Recall some very early memory and describe the imagery involved.]

38. *Observer A.* "(I recalled an incident which happened when, at the age of 4, I was travelling with my mother.) I was first aware of visual imagery of an indefinite extent of water, covering an area of about the size of a city block; the water was smooth and dark green in color; forming a frame for this visual imagery, on one side, were the inside furnishings of a car such as are visible between the car windows, the distinct features of which were shades of dark, yellowish brown. This imagery was at once followed by a focusing of visual attention upon a spot on the surface of the water at which there bobbed up from beneath the surface the head and back of a turtle, with its back turned toward us. Then the turtle was seen to turn about as it swam along the surface of the water and to face directly toward us while its back disappeared beneath the surface. (This was all that occurred in my memory consciousness and the imagery involved was wholly visual.)"

39. *Observer A.* Same instructions. "(I recalled an early childhood experience with a ferocious dog.) First there appeared visual imagery of an open barn doorway; the space in this doorway was for the most part dark with no visible objects except near the bottom of the doorway where I visualized a mass of light, straw-colored stuff covering the floor; I saw no floor around this colored mass but only the darkness which filled the doorway. No detail stood out in this imagery except the color. I then found myself interpreting this mass of stuff as a pile of corn-stalks. To the right of the corn-stalks I visualized a dog, tied by a heavy chain, and sitting quietly upon his

*Experiments on taste and smell indicate results similar to those obtained in series 1. Owing to the length of this monograph, therefore, these results have been omitted.

haunches, facing me. This imagery was rather hazy as to outline and the only definite features were its sitting position, its dark-tan color except for a patch of much lighter tan on his chest. Eyes, legs, hair, etc. did not stand out in the imagery. Surrounding the dog was a background of dark grey space which became darker a short distance from it and from hence blended into the corn-stalks on the left and into nothing above and to the right, except the darkness which filled the doorway. About the framework of the doorway extended a grey background, filling the remainder of my field of vision. The visualized objects appeared as if I were approaching the door from directly in front. By my side there appeared a reddish brown object which assumed the vague shape of a child companion the color of which meant that my companion was a sister. All of this was followed by visual imagery of approaching the dog and of annoying it with one of the corn-stalks. This was largely an interpretation from a change in the scene; I now found myself, in imaginal terms, directly in front of the dog and between it and the pile of stalks. Then I was aware of intense barking of the dog, not in terms of auditory imagery but purely in terms of vivid yellowish-grey cloud-like forms which issued from the region of the dog's mouth. I also visualized the dog pulling at his chain and trying to reach us. At this juncture the imagery became so vivid that the experience seemed almost real—it became tridimensional rather than remaining photographic as does much of my visual imagery. Then, for a moment the entire region involved in my visual imagery was filled with brilliant but hazy streaks or ribbons of light, colored a silvery white with reddish and 'creamy' spots. This latter imagery represented my sister's screams but there was no auditory imagery present. The whole memory was exceedingly clear but of short duration. (Each time I recall this experience this imagery tends to appear in the order described above; and so far as I can tell, it has not changed in detail or quality for years.)"

40. *Observer A.* Same instructions. "(I recalled my first visit to the Blind School, at which time I was escorted about the grounds and through the buildings by the superintendent's wife, who told me about the things I would learn and how I would study geography and other lessons.) At the outset I had visual imagery of the expansive grounds; this consisted first of a winding cement sidewalk, of a broad expanse of yellowish-brown, dead grass with trees scattered here and there on both sides of the walk. This imagery was photographic and possessed almost no detail. I could not make out the individual blades of grass; the area in my image, covered by the dead grass, was a smooth, washed color; the trees to the right and to the left were seen as if I were approaching the school building from along the walk; the scene shifted as I imagined myself advancing toward the school itself, although I had no motor imagery of walking; I found myself attending to no particular tree; only the trunks and lower branches of the trees were visible; above, the imagery merged at once into nothingness or at best a vague setting of neutral grey. The trunks of the trees had no definitely outlined shape or size and the branched portions which were visible were a poorly saturated darkish green. Here and there only did much detail stand out for mostly mere areas of color represented the green portions of the trees; this color, however, was sufficiently definite and characteristic to tell me that the trees were fir. Then I had faint and fleeting visual imagery of the superintendent's wife standing before me; the image assumed the general shape of a human form the distinct feature of which was its color and brightness—a certain light yellow. (At this juncture in my memory, I recall that she told me that she was going to show me about the place; but here I had no auditory imagery. This is an interpretation. I remember, also, my feeling reaction at the time which now consists of a reinstatement of an organic complex.) I was next aware of a sinking sensation somewhere in the region of my stomach or abdomen—I think diaphragm; of an incipient tightening about the back and shoulder muscles as if I were beginning to resist something; there was nothing in my visual imagery which might suggest an

unpleasant reaction but at the time of the incident I judged the superintendent's wife as regal and cold; I now recall this feature of the experience in terms of verbal interpretation and of the organic reaction which I have just described. Next I had visual imagery of being on the back porch where I visualized a hammock which one of the pupils at the school had just finished making. Then the scene changed to that of a school room; I saw, in my visual imagery, one end of the room; my attention was first centered upon a globe which was about three and one-half feet in diameter; the visible surface of the globe was washed with a dull waxy-like green light, regions of which represented water and the darker regions of which represented land and mountains. Behind the globe I visualized a plain grey wall with no detail. From here my attention shifted to visual imagery of dissected maps lying on a desk; I saw the sections distinctly, lying there in their different shades of natural wood color, but further than this no details were present. I recall now, indirectly, that I inspected these pieces at the time and marveled at the fine workmanship involved in making them. This, however, comes to me in verbal fashion. Throughout the whole experience, attention shifted from one visual image to another without pause and without any slumping in attention. (By voluntary effort I am now able to construct tactual and motor imagery but during the spontaneous recall no such imagery was present.)"

41. *Observer B.* Same instructions. "(The first memory which entered my mind upon hearing the instructions was that of going to a public school before I lost my sight. I snatched a stick of candy from a playmate while on the way to school, and ran away with it. In recalling the incident I had no visual imagery whatever. Practically all of my imagery consisted of verbal processes having to do with relating the experience.) I was first aware of this memory in terms of an incipient verbal image, 'school,' followed by incipient motor imagery of arm-movements of grasping what I later interpreted, verbally, to be a piece of candy; I then had kinaesthetic imagery of leg movements of running. (I suppose that practically all of this imagery arises in the process of recall, not from memory, but from the process of relating the incident. I feel I had no real memory imagery of the experience at all.)"

42. *Observer B.* Same instructions. "(The most vivid of my early memories is the recall of my accident.) At the outset I had a fleeting visual image, suggested by an antecedent verbal process, 'accident,' of the house across the street from the place where the accident occurred; for the briefest flash of a second this image was vivid and real but it disappeared almost as soon as it came. This imagery included a small section of a muddy street, part of an old wooden fence in front of the house, the dull wintery sky overhead and a snow-covered hill in the background. This imagery lasted for so short a time that I perceived these objects as wholes and was aware of no particular details. Next I had motor imagery of groping about, immediately following an (implied) explosion; then followed kinaesthetic imagery of stumbling and tactual-kinaesthetic imagery of being held in the arms of a companion who ran to me. A host of imagery then followed, including auditory imagery of my father's exclamation when he first saw me, of my mother's voice and of a friend's who was present when I was taken home; kinaesthetic imagery of sitting in a chair in the kitchen (kitchen interpreted) while my mother washed my face and hands. Accompanying this was faint, fleeting visual imagery—merely a shadow—of my friend. Accompanying this imagery were affective-organic processes which invariably recur as I think of the accident. These involve tendencies toward changes in respiration, tensions in the muscles of my chest, throat and face."

43. *Observer B.* Same instructions. "(I have recalled my first visit to the blind school.) In the beginning I had auditory imagery of my mother saying:

'We are here.' This was followed by distinct and intense auditory imagery of the teacher's voice telling me that I would learn to make different things; then came fleeting and faint tactual imagery of bead baskets and other kinds of baskets, kinaesthetic imagery of moving my hands over these and other objects. (From this point on I am not certain that I am really recalling events which actually took place at that time.) I then found myself constructing tactual and kinaesthetic imagery of objects of various kinds—cane-seated chairs, hammocks, games and the like. These images lack the background consciousness of recognizing or of labeling my experiences as old, familiar events."

ii. Summary of introspective data on early memories.

Observer A. We are not interested in discussing early memories as such for the reason that our principal purpose is to comment upon the appearance of synaesthetic processes in *A's* consciousness of early childhood events. The imagery of his early memories is throughout entirely visual. Only as his visual contents suggest verbal associations or verbal acts of interpreting these contents, is *A's* early memory consciousness characterized by any other modality than the visual. The most prominent features of this visual imagery consist of their photographic nature, their emphasis upon color and degrees of brightness, their invariable visual setting of neutral grey, their dim, indistinct outlines and lack of minute detail. The most interesting feature of *A's* early memories is, for us, the fact that colors and shades of brightness stand alone in consciousness as representatives of auditory, tactual or other non-visual experiences which he had at the time. This fact indicates that *A's* synaesthesia developed very early in childhood; so early in fact, that his very oldest memories are synaesthetic.

In an incident during which *A* and his sister annoyed a dog, chained in a barn, *A* heard the barking of the dog and his sister's screams but these sounds are not remembered in terms of auditory images. At the time of the incident these sounds were colored. The colors are remembered but not the sounds. Striking is the fact that the behavior of these dissociated or detached colors faithfully describes the intensity of the dog's barks and the intensity and fearfulness of his sister's screams. The affective reaction which *A* experienced at the time and which has been forgotten, as such, is now recalled in terms of its detached visual accompaniment. These dissociated synaesthetic images appear in a visual setting which assists in ascribing to them their proper meaning in the absence of the imagery for which they stand. They are also interpreted concretely by verbal processes. Vocal-motor imagery func-

tions also in filling out other deleted contents. For example, *A* recalled that he picked up a cornstalk and threw it at the dog but has no direct memory imagery of doing so. This item appears as a verbal process in relating the incident.

Observer B. B's early memories are visual, auditory, tactual and kinaesthetic in their contents. His very earliest memories are exceedingly attenuated and fleeting and are so lacking in direct content that practically the entire process of recall consists of the verbal processes having to do with the relating of the incident. None of these imaginal contents of early memories possess the richness of detail, nor the durability of ordinary processes of imaging objects or events, with the one exception of the visual which possesses greater definiteness and quantity of detail in early memories than in any other functional group of *B's* mental contents. But such visual images as do occur in early memories appear and disappear with a flash and only in rare instances can they be revived or prolonged. The fact that more visual imagery is present in his early memories than is present in his thinking processes in general may be explained on the ground that at the time of these early events *B* could either see or he had vivid visual imagery. It is of importance to note that detailed or clear visual imagery appears only in certain contexts and that these contexts are those which developed at a time when *B* employed visual processes. This suggests that the ability to arouse or to employ imagery of certain types, generally, depends upon the development of certain definite contexts in which the desired image and the cue which is used in ushering this image into consciousness must be such as frequently appear together in consciousness. Thus *B's* visual images, in early memories, are more or less detached phenomena; they are images which have no specific value in his conscious life, relatively speaking; they, as well as the cues which arouse them, appear relatively infrequently; the one will not appear without the other. It would be interesting to speculate whether the fact that *B* can have fairly distinct visual imagery in early memories and not in ordinary thinking is really due to a decay of his visual modality or whether it is simply due to the fact that because of the continued absence of visual sensory processes he has formed habits of developing only such contents—complex groupings or successions—as are constantly functioning in sensory experience proper. We are inclined to believe that if his visual modality were decaying we would find evi-

dence of it in *every* visual image, and that the presence of clear and detailed visual imagery in one context means that visual contents, as such, have not decayed. It points to the fact that the functions of developing contexts in which visual imagery appears have decayed rather than contents *per se.*

While this observation is not a new one in the psychological literature, its importance has not, evidently, been appreciated. It throws light upon the much discussed problem of act and content. It indicates that contents and acts are mutually exclusive data but that they are dependent variables. The one cannot exist without the other. The content is the mode by which the act takes place. Any act or event must take place in a certain mode and by this mode we mean the method or procedure by which the action takes place. The content is the *form* of the act. The former is inevitably structure, *i. e.,* it is static while the latter is inevitably function—it is dynamic. In crude language the content is the thing which is acting. But the content is in a last analysis a practical and arbitrary abstraction whose limits must, in actuality, be as flexible as the act of which it is the form. In other words mental contents are the forms in which mental activities exist. If a content has decayed it implies that a function has likewise decayed and *vice versa.* It would be misleading to say that *B's* visual modality has decayed, for it presumes that his mental functions have throughout remained intact. With decaying mental contents —if they have decayed—there has occurred a decay in such processes of abstracting data from habitually used experiences as will supply contents for further experiences. A deleting in *B's* processes of abstraction has occurred together with deletion in visual imagery. If decay in visual imagery has occurred this decay has taken along with it corresponding processes of attending, associating, controlling, deriving of meanings, recognition and the like, all of which have been supplanted by similar functions dealing with images in other modalities. As a result of this dual decay—if it can be called decay—we should expect that deletion in processes of associating, controlling, deriving meanings, recognition and the like would force *B* to develop new contexts in which visual imagery would not and could not appear and that wherever visual imagery does appear it of necessity exists only in such contexts in which it

can be associated, controlled, and recognized. *B's* early memories are isolated contexts as well as contents; they are isolated functional as well as structural groups. This, we believe, explains why detailed visual imagery appears in one conscious setting and not in another. With the loss of visual imagery go the cues which will arouse this imagery; such visual imagery as does persist is only that imagery whose cues have not likewise disappeared. Contents which are present in the context of early memories provide these cues and no other cues will suffice to arouse this visual imagery.

We find evidence of all this in *B's* early memories themselves. Not only is visual imagery fleeting and uncertain but also is the entire early memory consciousness. Where contextual imagery from other modalities is definite so is the visual; where contextual imagery is lacking, so also is the visual; where the visual image itself is definite there is a cue which suggests it; where the visual image is lacking there is also lacking the cue which will suggest it; other cues fail to produce the image, to prolong or to revive it. In the absence of old processes of associating, attending, controlling, and the like, all of which have gone with the visual imagery itself, *B's* mental procedure, during the act of recall is, of necessity, concerned with new and other things, namely, verbal processes of interpreting, processes of supplementing, constructing new contexts, and the like. Hence we find him relating in terms of vocal-motor imagery the incident of having snatched a piece of candy from a boy companion when he was on the way to school at a very early age; we find him tending to fill out the memory of his first visit to the blind school in terms of tactual and kinaesthetic imagery which he is certain is not direct memory imagery. Old contexts disappear and with them the old contents and in their places appear both new contents and new contexts. Whether the old have decayed or have merely become detached from the proper cues for their arousal is but a matter of speculation.

iii. Early memories of A and B compared.

1. While *B's* early memories contain relatively more visual contents than do groups of images which appear in other contexts, *A's* early memories show no such marked difference. It seems probable that the latter's visual imagery has been kept "alive" both by his entoptic phenomenon and by his constant use of visual imagery in synaesthetic phenomena and in synaesthesia proper.

2. *B's* early memories have undergone processes of deletion or degeneration of a type which is not to be found in *A*. Owing to the dropping out of visual contexts in *B's* everyday experience we believe that not only visual contents but entire functional constellations have disappeared from *B's* mental life and that these constellations involved the cues necessary for the arousal of visual contents. But in *A's* case, owing to synaesthetic functions and to an entoptic phenomenon from both of which he has been able to abstract contents for future use, cues and contents, alike, have been retained. Undoubtedly *A's* early memories have undergone processes of attenuation and perhaps of elaboration as have *B's* but the former's visual contexts have remained intact throughout his mental life. He has not, like *B,* suffered dissociation of visual functions to the extent that visual imagery appears only in a small group of contexts having to do with early memories.

iv. Significance of synaesthetic phenomena in A's early memories.

A's early memories throw added light upon the evident value of his synaesthetic imagery. That sounds, affective states, and in fact all forms of non-visual experiences should be retained in terms of their detached visual associates is consistent with our view that in his case non-visual experiences cannot be attended to as such. This means that they cannot be experienced as such and therefore that they cannot be revived or recalled as such. Since, therefore, all non-visual images are vague and undifferentiated experiences until they become visual, they are unstable and subject to early decay or dissociation from their visual accompaniments. An experience that is to be recalled must be one which can be voluntarily controlled or one which is subject to arousal by the method of cues. Unstable and easily dissociated processes are less subject to control by means of cues. On the other hand the visual associates are stable; they are stereotyped and being concrete, definite experiences as well, they are the processes which become more strongly integrated into various patterns of response. They are the processes, then, which are more subject to voluntary control. As a result of these conditions we should expect, then, that the visual rather than the non-visual half of a synaesthetic experience would be the one which is retained. In other words that half of the synaesthetic experience is retained to which definite attributes, qualities and meaning are originally ascribed, and since it is to the visual half of the synaesthetic experience to which definite qualities and mean-

ing are ascribed, it is the visual image rather than its vague and meaningless parent process which survives in the memory context.

The visual image, in any given synaesthetic experience, is stronger than its parallel sensory process. We have already seen that in synaesthetic phenomena the associated image is stronger than the parent image. It is the associated visual image which claims attention rather than the non-visual half of the process. As we shall see later, the same condition obtains in synaesthesia proper, *i. e.*, when the primary process to which the image is attached is a sensation rather than an image. It is not surprising that the stronger of the two factors in synaesthesia should survive and that the primary but weaker factor should decay or disappear in the process of forgetting.

b. Recent memories.

i. Typical introspective data.

[Instructions: Recall a recent incident and describe in detail all of the imagery involved.]

44. *Observer A.* "(I recalled a fishing incident which occurred about a week ago.) I first had visual imagery of myself standing in the rear end of a boat about half of which was visualized as being the drab color of water-soaked wood. I was holding a fishing rod in my hand. Out in front of me was stretched a smooth, level expanse of greenish-olive colored water and at the far end of this expanse, about fifty yards away, I visualized a bright, white cloud-like 'bank'; over this 'bank' I was rapidly moving my line of regard and could detect slight kinaesthesis of eye-movement as I did so. This white 'bank' represented rapids farther down the creek. The shores of the creek were visualized a grey and were indistinct save for the fact that they were definitely projected about 50 feet from me on either side. Above me I was dimly conscious of something black; I had kinaesthetic imagery of crouching beneath it. This black mass meant to me overhanging willows and alders into which I had been fouling my fishing tackle. The willows and alders were visualized in the same black as accompanies kinaesthetic sensations and I am certain that this was due to the fact that this visual imagery was affected by the accompanying kinaesthesis of avoiding the branches and by the tensions having to do with imaged crouching movements and fear that my fishing tackle would become fouled. Together with this kinaesthesis there appeared distinct organic images, colored, of unpleasantness. These were localized from my shoulders down to the region of my belt. Then I recalled two distinct pulls at my pole. Thereupon I recalled kinaesthetic imagery of tightening my muscles in my arms and chest while at the same time I visualized my hands upon the pole and myself working the reel. There accompanied these latter experiences a projected tactual-like image out in the water at the end of the line. This projected tactual image consisted of two dark blots out upon the greenish-olive water. (This imagery puzzled me for a moment. I am unable to identify it either as tactual in origin or as kinaesthetic. If it is tactual-pressure in origin why should it not be localized in my hands where there was nothing but purely visual imagery of white hands? If it was kinaesthetic why wasn't it localized in my arms? But watch the development of this projected image.) I next recalled a sound of a splash coming from the region at which these two dark blots had been visualized. This splash appeared as

a white spire-like form of brightness about a foot high and extending upward from the green surface of the water. I identified this as a pure synaesthetic image for the reason that if it had been a visualized splashing of water instead of a symbol for the sound of the splash, there would have appeared concentric wavelets irradiating out from it. Immediately in front of this visualized auditory splash I visualized the head and gills of a fish, with its mouth open—just as a fish appears when fighting a hook. Before this visual image of the fish became definite in outline and clear as to details it was obliterated by a black streak, irregularly formed like the tongue of a lightning flash; this black streak shot out and away from the place at which the fish-head had just been visualized and behaved on the surface of the water very much as a shadow would behave upon a screen which moved about. This movement of the black streak I at once interpreted as the movement and progress of the fish from place to place beneath the water. I then recalled attempting to check it with arm-movement; this latter consisted of kinaesthetic imagery of arm-movement together with incipient tensions. Here, again, the movements of the fish seemed to be colored by my kinaesthesis of trying to check these movements. The entire experience through here was rendered more vivid in color due to the unpleasantness from the overhanging branches and also to anxiety concerning my old last year's fish line which was not in the best of condition. The unpleasantness appeared in the form of fleeting organic sensations which in themselves were more or less indescribable other than as to their bodily localization in jaws, shoulders and chest; but they were followed at once in consciousness by vivid dark browns and blacks. The kinaesthetic element in this affective toning is very strong and shows up clearly in the blackness of the visual associates. Both organic and kinaesthetic processes disappeared before the visual, leaving the latter as visualized regions about my arms, shoulders and chest. I then recalled synaesthetic imagery of my own voice—a poorly saturated bluish-brown, but I was unable to recall what I said. By this time the olive-green water had become very much 'streaked' with these lightning shaped ribbons of black, requiring considerable eye-movement to follow them out to their terminations. Then, very, very suddenly all of these streakings vanished and again appeared the smooth expanse of olive-drab water. I visualized myself lifting the pole until it nearly touched the black, visualized overhanging trees and out from the water where I had been seeing the black streaks appeared about 18 inches of a bluish fish-line with the end dangling above the water about six inches. At the very tip of the line appeared a small, brilliant white light which was interpreted as the broken end. (I forgot to mention that the fish's head was visualized as a bluish-white. I am now convinced that the two black, projected blots at the end of the fish-line were projected visualizations of the two sharp tugs on the line as the fish was biting. They were colored black owing to the influence of my black kinaesthetic synaesthesis.)"

45. *Observer A.* Same instructions. "(I recalled a recent ball game which I attended.) There first appeared visual imagery of the ball ground stretched out before me; I recognized features about the field, however, which indicated that it was not the ball ground to which I recently went which I saw in my imagery but a field which I used to play on when a boy. No detail stood out in this diamond-shaped field until my visual attention was claimed by the region about the home plate; then there appeared the background of fir trees and the broken-down fence beyond the out-field. The trees were not distinct as to outline but merely green, conical shaped forms; the fence consisted of rather blurred rod-like bands of grey—the color of weatherbeaten boards. I could not see the players other than as vague moving forms of dark grey; I then saw myself sitting upon the bleachers. (When I attended this particular game I did not visualize the field before me but the field which I have just described.) I could not get any auditory imagery of the sounds from the players or from the grand-stand, nor did I have any memory imagery of climb-

ing onto the bleachers, but I had fairly definite images of face-like shapes thickly distributed about me and among some of these faces I recalled familiar colors representing certain individual persons whom I knew. I was able to see the general shape of certain faces but these forms had no other detail other than their peculiar coloring. Unfamiliar faces were mere round forms of grey. The faces which stood out the clearest were those of students who rooted the hardest and whose voices I recognized during the game; the faces are colored according to the colors of these voices. All of this was followed by developing tendencies to visualize my legs in a very light-grey color; as I fixed my attention upon this imagery for a moment there developed faint tactual imagery of the cold wind, blowing against my legs, whereupon this light-grey imagery became much brighter. Then I visualized wide black streaks across the middle of my back and in the lombar region; this constituted my remembrance of back strains as I sat for a long time upon the bleachers with no support behind me; this latter imagery in turn was followed by kinaesthetic imagery of these back strains and again the color was made more intense. As I lingered upon the kinaesthetic qualities, however, which at first were very indistinct, they tended to give way to visual qualities entirely, which latter persisted much longer."

46. *Observer B.* Similar instructions. "(I recalled a certain portion of a walk which we took not long ago, through a wooded section of country and over a winding trail.) First there appeared auditory imagery of the footsteps of the man who was walking in front of me; then sketchy auditory imagery of his voice in which the peculiar pitch and timbre of his voice stood out rather than any particular words which he said. This was followed by auditory imagery of the footsteps of the man behind me; the latter were characterized by their heavier thud as his feet struck the ground. Then followed in very rapid succession a mass of imagery; kinaesthetic images of walking up the steep slope of a hill; kinaesthetic imagery of swinging my arms, motor imagery of deep breathing-in of the fresh air, auditory imagery of a bird singing, tactual imagery of a flower which I carried for some time while on the walk; olfactory imagery of the flower, auditory imagery of a windmill which I heard off in the distance, auditory imagery of a cow stepping aside from the trail as we passed her by, auditory imagery of the cow's breathing, vocal-motor imagery of my voice saying, 'Gee! this is great!' and along with this latter imagery I was aware of slight tendencies to breathe more deeply during the recall, of tendencies for the muscles all over my body to become tense with exhilaration as I imaged the great expanse and freedom of the out-of-doors. Included in this organic and motor response were tendencies to crane my neck as if I were looking or listening to something far off in the distance. All of these images were so vivid and real that I tended to repeat the actual movements of walking as I was in the process of recalling the incident. While each image was fleeting, it was very clear and intense while it persisted; attention shifted suddenly from one process to another with almost no perceptible lag, during the entire procedure."

47. *Observer B.* Similar instructions. "(I recalled the last time I occupied the pulpit of a small country church.) I was first aware of auditory imagery of the organ playing a hymn, together with auditory-vocal-motor imagery of joining in the chorus with the congregation. This was followed by diffused tactual imagery of the warmth irradiating from a stove which stood near the pulpit, tactual imagery localized in my hand and forearm of resting against the top of the pulpit and tactual imagery of hitting my knees against the sides of the pulpit; then there was vague imagery which I presume was tactual, of the carpet beneath my feet; I recalled the people in terms of auditory imagery of the rustling of their clothes and in terms of rustling paper and books; I also had a confused tactual-motor-visual image of the church auditorium, resembling one's consciousness as he is approaching a wall; in this complex I vaguely distinguish a blank, shadowy form before me, faint coolness

and a low jumble of hardly distinguishable echos from the noises in the air. I then had distinct memories of the benches, partly visual, in the form of fleeting shadows, the only clear feature of which was the fact that these shadows appeared as curves aligned in a row; together with this latter imagery I had kinaesthetic imagery of arm-movement of feeling along the arms of the benches as I walked by. I had incipient motor tendencies of turning to the right which constituted an awareness that the organist was in that direction, but before this process developed to a focal degree of clearness I had hosts of kinaesthetic and tactual images concerned with feeling of the pulpit and with pacing back and forth behind it as I preached the sermon. During the process of this recall I had numerous incipient tensions about the face, neck, shoulders, arms and chest, together with visceral disturbances, all of which constituted the affective side of my mission in the church."

ii. Summary of introspective data on recent memories.

Observer A. The contents and functions alike are almost entirely visual in *A's* recent memories owing to the fact that during the original experience of the event recalled he is constantly translating non-visual experiences into visual images. Throughout his recent memories sounds, tactual experiences, kinaesthetic processes and in fact all non-visual experiences are recalled in terms of their dissociated visual symbols and these symbols are invariably identical with the visual imagery which was originally associated with the non-visual experiences. Of importance is the fact that at times these dissociated visual symbols suggest their parent processes. For example in recalling the experience of fishing *A* was first aware of a black mass over his head, colored black owing to kinaestheses of avoiding this mass which represented willow and alder branches above him. Then there appeared kinaesthetic imagery of crouching to avoid the over-hanging limbs. At another time *A* was aware of visualizing the calves of his legs in terms of light grey whereupon the parent process of this light grey appeared—a tactual image of the cool wind blowing against his legs (as he sat upon some bleachers watching a baseball game). At other times, however, the parent process does not appear. For example, in terms of the original visual concomitant, not in terms of auditory qualities, he was aware of "auditory imagery" of a fish splashing in the water as it was hooked. Or again, he had visual imagery of his own voice but no vestige of auditory qualities. In the process of forgetting, therefore, it is evident that *A's* auditory processes become dissociated from their visual accompaniments much earlier than do tactual and kinaesthetic qualities. And since kinaesthetic qualities appear in his recent memory content more frequently than do any other non-visual processes it seems safe to conclude that

kinaesthetic processes are less affected by dissociation than are processes from any other non-visual modality. It is significant in this connection to note that kinaesthetic processes have more definite features or attributes of their own than do any other non-visual experiences. *A* occasionally reports a fleeting but "pure" kinaesthetic image and by this he means that kinaesthetic qualities as such momentarily tend to become focalized in consciousness—a state of affairs which obtains for no other non-visual type of image. Nevertheless *A* cannot attend to a kinaesthetic process as such in the absence of its visual associate of blackness. There is no doubt, however, that qualities of tension, strain and movement may, momentarily, if but non-focally, be ascribed to kinaesthetic processes as such.

Thus it seems that while in his early memories *A* is unable to recall any original non-sensory experience other than in terms of its detached visual associate, in his recent memories *A* is able to recall the entire synaesthetic complex—the visual associate together with the parent, the non-visual process. If, however, the parent process does not appear along with its visual associate, the only procedure by which *A* is able to recall the former is by resorting to the method of fixing his attention upon the latter. It invariably happens that when the visual associate is lacking so is the parent process and the parent process can never be revived in the absence of the visual associate. Wherever a synaesthetic phenomenon appears in a memory consciousness it enters consciousness as one process; that is, provided the non-visual half of the phenomenon appears first it is never detached but merges very suddenly into the visual accompaniment.

Detached synaesthetic images function quite generally in *A's* processes of recall as the cues by which he obtains imagery of the primary and non-visual half of the original experience. If, for example, he wishes to recall the name of a certain person, the color which symbolizes that name will appear first and the name itself will be derived from the hue, shape, brightness or behavior of the visual cue. Thus in recalling past experiences synaesthetic phenomena are reversible; the presence of the detached visual image may lead at once to the advent into consciousness of the non-visual half of the original experience. The visual associate tends to appear first and then ushers into consciousness the primary image for which it stands. In synaesthetic phenomena, then, the associ-

ation may run in the direction of the secondary to the primary process in the case of recall but runs in the direction of primary to secondary process under conditions which do not involve recall. Observer *A* has become so familiar with large numbers of his stereotyped visual images that he can at will employ them as memory aids and does so constantly in conducting his classes in history, biology and in general science.

Notwithstanding this fact that synaesthetic phenomena are reversible, certain investigators in this field have affirmed the irreversibility of synaesthesia and as a consequence have been led to adopt a physiological theory. (See II, page 38.)

Observer B. B's recent memories are exceedingly rich in tactual auditory and kinaesthetic details, the kinaesthetic imagery tending to dominate and to be more definite and persistent than the other forms. Visual imagery is exceedingly rare and wherever present it is fused with tactual or motor processes; it is confined to shadowy forms or vague greyish extents of space and functions almost wholly in tactual-motor schemata. In other words, visual imagery is limited, in function, to contexts which have to do with awareness of space or extents as such. This suggests that one of the most stable of all of the visual attributes and perhaps the most primitive, is the attribute of extent. And since *B's* visual imagery is largely confined to greys, so far as brightness is concerned, brightness seems to follow extent as a next most stable or primitive attribute.

In his recent memory consciousness *B's* attention shifts with great rapidity from one qualitative detail of content to another, each quality as such standing out momentarily in consciousness.

iii. Our observers' recent memories compared with their earlier memories.

A's memories, throughout, are dominantly visual in their content. Old auditory, tactual and motor processes have become dissociated beyond voluntary control and only the visual associates have survived. As we examined his recent memories we found evidence that certain of the original tactual and kinaesthetic experiences had not yet "decayed" to the extent that they could not be recalled, although many of them had already become dissociated from their visual concomitants to the extent that only by hav-

ing recourse to the latter, which readily appear in consciousness, could the former be reinstated. But auditory experiences which dated back but a few days could not be recalled; only their detached visual associates would appear. Auditory imagery seems to be the first to suffer dissociation while kinaesthetic imagery is the last of the non-visual experiences to undergo such dissociation.

A change has occurred in *B's* memories as we pass from early to recent forms. But in *B's* case this change consists of a dropping out of visual imagery and of a gradual increase in the relative importance of kinaesthetic imagery.

As a consequence of these changes in both reagents—the diminishing amount of dissociation of synaesthetic phenomena in *A's* case and the increasing importance of kinaesthesis in *B's* case—we find a clue to the procedure by which images are aroused during the process of recall. *B's* kinaesthetic images function as stimuli for the arousal of tactual and auditory images while *A's* important cues are visual and are used in arousing tactual and kinaesthetic imagery and in unsuccessful attempts to arouse auditory imagery. *B's* visual functions seem to have decayed; *A's* not only have been retained but are functionally more useful as cues in his recent than in his early memories. Thus the lack of visual imagery in *B's* case and the dominance of it in *A's* case have produced opposite results. While this fact is in itself obvious, its importance in aiding one to understand the significance of *A's* synaesthetic phenomena cannot be over-estimated.

iv. Significance of synaesthetic phenomena in A's recent memories.

Results from *A's* recent memories confirm our interpretations from results on his early memories. (See page 62.) Not only are the visual associates far more stable and subject to voluntary control but they themselves are used as the means by which voluntary recall of non-visual experiences is exercised. These results also confirm our tentative view that synaesthetic processes function in the development of meaning. For we found that where one half of the synaesthetic process stood for the other half, one of these paired associates inevitably tended to lead to the other so long as the members of the pair had not become dissociated in the process of forgetting. And it made no difference which of these two asso-

ciates appeared first in consciousness. In other words, where meanings are reversible, so are synaesthetic phenomena.

Synaesthetic phenomena function in recent memories as they function in imagery and in early memories: the attributes of non-visual processes are ascribed to stereotyped concomitant visual imagery; and as a result, when this imagery becomes detached temporarily from its non-visual parent process it symbolizes or *means* that missing experience in that it may function in a meaningful complex of mental events just as if it were the original non-sensory process itself.

Still further evidence that synaesthetic processes play an important rôle in the development of meaning is to be found in the influence which the synaesthetic function may have upon such visual imagery as is not normally synaesthetic in character. In *A's* recent memory described in introspection 44, visual imagery of willow and alder trees was colored black when it normally would have been some shade of green and brown. The instant after this visualized blackness of the trees above him had appeared in consciousness *A* found himself becoming conscious of kinaesthetic imagery of crouching to avoid the branches. The kinaesthetic processes were anticipated in terms of the black synaesthetic image which always means kinaesthetic qualities when present in certain contexts. But when the black synaesthetic imagery appeared first in consciousness it was localized above him in the mass of trees which was to be avoided by means of muscular movement. Similarly the visualized movements of the fish which he had hooked were rendered black before kinaesthetic imagery of pulling on the line appeared in consciousness, and remained black throughout the subsequent presence of this kinaesthetic imagery. Again, kinaesthetic imagery of the tugs on the line as the fish struck the hook was represented in consciousness by visual synaesthetic imagery not localized in the usual fashion in the region of the muscles involved but projected out to the end of the fish-line as two black blots. In each instance the quality of black was the forerunner of a kinaesthetic image, and with the exception of the two black blots projected out at some distance from the observer on the surface of the water, the quality of black meant an *anticipated* kinaesthetic image. One would have expected that if *A* were about to anticipate a kinaesthetic image he would have visualized the willow

and alder trees, the movements of the fish and the tugging of the fish at the end of his line, all in ordinary fashion and in their natural colors, and would then have had visual imagery of blackened regions localized in the musculature involved in the subsequent kinaesthetic imagery. But there was evidently a process of foreshortening in his mental processes. He left out the black regions localized in the musculature and instead, blackened the antecedent visual imagery. One might interpret this state of affairs as a process of attenuation or short cutting in *A's* mental functions where synaesthetic processes are involved; or one might assume that a process of irradiation has taken place in a forward direction in the particular response pattern which involved, for example, willow trees and crouching movements. Whatever may be the particular method by which synaesthetic functions thus affect adjacent mental contents in any given complex of imagery it is evident that we here find a situation similar to that described in introspection 6. We there noted that visual imagery of a particular person was identified in terms of the same color which appeared in connection with that person's voice. We found that all imagery having to do with that particular person was affected by this same color, obviously pointing to the fact that the color had to do with *meaning*. So in the peculiar functioning of synaesthetic processes which we have just been considering, willow trees *meant* something to *A* aside from being mere willow trees; they were trees-to-be-avoided-in-kinaesthetic-fashion and this meaning was present in terms of trees visualized in black—the black of the forthcoming kinaesthetic imagery of crouching. The movements of the fish meant to *A* movements-to-be-checked and were thus colored the black of kinaesthetic movements of pulling on the line. The black blots mentioned above present a similar problem.

Accordingly *A* did not have to stop and think: "Here are willow trees which are very close to my head and therefore if I do not crouch down I will hit them or my fish tackle will become fouled." The meaning of the entire siutation was reduced to its simplest terms—*black* trees. The visualized movements of the fish meant more than mere movements of the fish. The movements were *black* and thus they meant: "The fish is darting rapidly about in the water; I must keep the line taut." Such is syncopation in meaning *par excellence!* As visual imagery of a person is

colored and thus comes to mean imagery-of-a-*certain*-person, so imagery of a willow tree and the movement of a fish come to mean, in a memory consciousness, objects-which-were-responded-to-in-*certain* fashion.

C. Series 3. Imagery in constructive imagination.

i. Typical introspective data.

[Instructions: Imagine yourself standing upon the corner of 25th and Broadway, New York City, and give a complete introspective description of your mental processes.]

48. *Observer A.* "(I assume that I was standing on the curb for the reason that I was aware of people passing behind me and of the traffic in front of me.) At the outset I was aware of visualizing a telephone pole very near me at my right side; it was a typical Oregon second-growth fir pole, colored the light yellow-tan of fir wood with the bark just removed; this imagery extended only to my shoulders and loomed up vividly in front of a grey background. Together with this imagery I had very faint tactual imagery of a 'tingling' in the skin about my forehead and an incipient kinaesthetic process of drawing away from the image of the pole; all of this constituted an awareness that the pole was very near me. Next my attention turned to visual imagery of a paved street, in a light cement-like grey, which presented a smooth appearance unbroken or uninterrupted by street car lines or moving objects; at this juncture the street was empty; then I completed this visual image by seeing masses of forms, small and large, dark and light, passing by me in both directions and in two streams, the nearer one going to the left and the farther one to the right. Momentarily I shifted my visual attention from one of these moving streams of forms to the other and tended to follow each with eye-movement. Along with this visual imagery I had faint auditory imagery of wheels rumbling along the pavement and together with this dim roar—the only auditory imagery appearing in the entire process of imagination—the grey of the street became darker. The brightness and distribution of these forms constantly changed; many of the forms themselves were not visualized objects but visual synaesthetic images of the varied sounds which characterize street traffic; their constant shiftings in brightness and in position meant to me moving vehicles which were 'noisy.' Many of these fleeting visual symbols were too sketchy to describe but I singled out the visualized tooting of auto horns and the chugging of the motors by means of concentric rings of differently shaded grey lights and spasmodic puffs of whiter light. The visualized chugging of the motors was seen to issue from behind fleeting forms which latter meant the machines themselves. Concentric rings of shaded light, patterned something like the markings of a snake, stood for alternating weak and loud intensities of the chugging; the light portions indicated the explosions and the fainter portions stood for the intervals between the explosions. Then my visual attention shifted to the far side of the street where I momentarily saw high, shadowy forms looming skyward and together with this imagery I was aware of incipient motor tendencies in neck and eyes to look upward. By attending to these shadow forms I was able to distinguish large show windows dotted with color. Then I was aware of people behind me in terms of visual images of heels with halos of black around them; these halos were visualizations of the noise of footsteps. I could then build out, voluntarily, masculine and feminine voices, not in terms of auditory images but in terms of silvery ribbon-shaped visual forms for the feminine and darker, splotchy clouds for the masculine; these ribbon-shaped and cloud-shaped forms emanated from vaguely visualized mouths. The visualized sounds claimed my attention and I at no time tended to construct visual imagery of the persons themselves. During the entire pro-

cess I had no verbal imagery; I had no noticeable motor imagery other than what I have mentioned. (I have often observed that I can visualize objects directly behind my head without tendencies to move, or at least without noticeable tendencies.) Now, as I project objects behind my head, with attention centered upon an *Aufgabe* to notice any possible motor imagery, I am aware of slight tendencies toward eye-movement. I do not notice this movement, ordinarily. [Subsequent tests revealed the fact that in all shifts of visual attention there was either imagery of eye-movement or incipient eye tension. It will be noticed that *A* mentioned tactual imagery early in this introspection and reported no accompanying visual synaesthetic imagery. At times such an incident happens but upon reinstating this imagery or upon introspecting more carefully, it invariably turns out that *A* had visual imagery and that he was describing the tactual image by having recourse to the visual associate. Since the visual associate meant that the image was tactual, he called it a tactual image.]"

49. *Observer B.* Similar instructions. "I hardly know where to begin. There first appeared very real and intense tactual imagery of the cement walk beneath my feet; then followed auditory imagery, relatively not so real or intense as the tactual, of automobiles passing by, of wagons, street cars, horses and people all hurrying by me in blurred confusion of noice; I detected the rumble of people's voices, their footsteps, the rustling of their clothes. All of this imagery appeared and disappeared very rapidly with exceedingly swift shifts of attention from one detail to another. Then there appeared an awareness of a large building near me, consisting in part of a 'shadow feeling'—a vague, diffuse visual image of a shadow looming up at my side, together with very slight and incipient tendencies to draw myself together as if I were about to stop, hesitate, or shrink back. Then my attention shifted to a different group of processes consisting of incipient tensions about my neck and chest, tendencies in the region of the trunk and abdomen which I interpret as incipient contractions, a general muscular tendency to stand up straighter. All of this constituted a tendency to adopt a listening or expectant attitude as I imaged myself, kinaesthetic fashion, preparing to find my way across the street. Then appeared very shadowy and fleeting visual imagery of wagon wheels, of wagons and of automobiles turning around a corner toward me; this visual imagery had no setting of a visual sort; the wagon wheels were the only objects which approximated clearness and here I found, on closer introspection, that my visual image was two-thirds kinaesthetic and consisted of motor imagery of arm and shoulder as though my hand were following a certain point on the rim of the wheel during its revolutions. These experiences were followed by affective processes consisting of chest tensions, deeper breathing, motor imagery of unsteadiness—as if I were nervously keyed up and found it hard to tell in what direction I should proceed across the street. I then had tactual imagery of the sun's warmth upon my face; tactual imagery of holding a cane in my hand and kinaesthetic imagery of gripping the cane. During all this time my attention had been shifting suddenly from one detail to another, centering longer, however, on the motor imagery than upon any other type."

[Instructions: Imagine yourself taking a flight in an aeroplane. Report your imagery and other processes involved.]

50. *Observer A.* "To begin with I had very diffused kinaesthetic imagery of being in a sitting position and this imagery, under the instructions, meant sitting in an aeroplane; this was at once followed by the beginnings of a consciousness that I was in mid-air—an interpretation which, so far as I can tell, developed in the absence of no tendencies toward slight muscular tenseness about the face, shoulders and chest. (Whenever I am conscious of being near objects there exists this tenseness just referred to.) Then my attention shifted to a visualized roaring of the motor which consisted of a great mass of inky black rolls of smoke which seemed to cover an area in space about me the size of two city blocks. This 'smoke' obscured everything; it was dense

and thick, even rendering imperceptible my entoptic sensations; I was able to visualize nothing in or through this mass, neither was I able to obtain any auditory qualities of the roaring motor. I found it impossible to retain my present vantage point in my imagery, and visualize any objects beneath me or around me; I had to imagine myself situated off at one side or beneath this mass or imagine that the mass had been divided in two parts, leaving a 'cut' through which I could 'see' objects in the distance. I could not 'see' myself in the aeroplane and at the same time visualize anything else but the 'smoke,' for my visual attention was claimed by this blackness under these conditions—*i. e.*, so long as I was trying to imagine the sound of the motor. The instant I changed the *Aufgabe* from that of imaging the roaring motor to that of visualizing objects around or beneath me, the black 'smoke' disappeared; it simply melted away. I could not construct motor or tactual imagery of being hurled through space but I had a faint organic sensation of being lifted and dropped suddenly. (As I introspect I am able to obtain tactual imagery of wind pressing against my face and auditory imagery of the wind whistling by my ears but the mental content is entirely visual; I have no perceptible tactual and auditory qualities.)"

[Instructions: Imagine the world one million years ago and describe all the mental processes involved.]

51. *Observer A.* "I first had visual imagery of a European map built up from my anthropology and geology studies. In this visual imagery, which covered a large area spread out before me like a wall map, I saw at first only the boundary line between France and Germany; the rest of the map then cleared up and my visual attention suddenly shifted and I seemed to be in space just above a flat expanse of territory, rank with vegetation. This consisted of a rapid melting away of my visualized map before the developing visual image of a vast plane, colored a rich, deep green, and on which, here and there, I distinctly made out thickly growing fern stems and patches of palm leaves stretched out like fans. These latter were of a still darker green and were smooth and waxy in appearance. Then I had visual imagery of huge mastodons, in which only their huge bulks and general forms were definitely outlined; they were elephant-color. The scene suddenly changed to a 'close-up' view of one of these beasts; here I visualized the huge head with two long, curved, shiny, white tusks; narrow slits where the eyes belong, colored almost a black, and two flap shaped ears. I then constructed, in my visual imagery, fairly definite details about the joints of the forelegs. The imagery did not include definite details about the remaining portions of the animal; the remainder of my visual image of it merely included an undifferentiated mass of grey assuming the general shape of an elephant but larger. Then I had very fleeting visual imagery of a saber-toothed tiger—a fleeting cat-like form, streaked with color, slinking through the rank vegetative growth. This was followed by visual imagery of a primitive man, standing in a clearing before me; the clearing was suggested by the lightness of the green about him, compared to the dark forest background which had characterized my previous imagery. I saw this man naked, of stout, hairy body, with the hair especially black (blackness representing thickness) on his chest and on the front sides of his arms. On his chest there stood out very plainly little curly tufts in which I could make out individual hairs; in this visual imagery there also stood out the fact that the hair ran in different directions on different parts of the body, suggested by the shading in the blackness. Then I saw the man skulking about and trying to keep as closely under the cover of the forest as possible. The entire experience was rich in detail—the details standing out one after another as visual attention shifted from one feature in my imagery to another. There was no break in visual continuity and no tendency for visual imagery to shift or give way to imagery in any other modality. Was not conscious of vocal-motor imagery at any time during the experience."

52. *Observer B.* [Instructions same as for introspection 51.] "(I was intensely surprised to have fairly vivid visual imagery.) There first appeared rather lasting, clear and intense visual imagery of green trees, swaying in the wind. I saw them going on and on in the distance, indefinitely, tossing and tossing, one set of branches giving way to another as if I were passing them on a moving stage. (I suppose that this imagery was not as perfect or detailed as would have been the imagery of a sighted person, nor was it as stable.) This imagery lasted perhaps for a second but it seemed much longer, and then faded into kinaesthetic-tactual imagery of lying flat on my stomach and of reaching my arms out over a sea of space and what was my visualized field of branches but an instant before; very vivid and intense was the imagery of upper arm and shoulder as I imaged myself swinging my arms and together with this there appeared almost equally as intense imagery, with incipient movements, of taking long deep breaths. All of this called up vocal-motor imagery of such words as 'gigantic', 'sweeping', 'forest', 'primeval', 'terrible vastness', 'massive' and the like. Then I was aware of kinaesthetic imagery of making large sweeping arcs with my arm, as if I were pointing out to some one a vast expansive territory. There then followed tactual imagery of thick grass about my feet and of grass twining around my ankles."

[Instructions: Imagine yourself walking a tight-rope.]

53. *Observer* A. "At first I could get very complicated kinaesthetic imagery, together with visual imagery of the rope stretched beneath my feet and visual imagery of my feet upon the rope. The ends of the rope were not visible nor were the objects to which the rope was attached. The motor imagery consisted first of swaying my legs rapidly to and fro sidewise as the rope swayed in that fashion; for a moment this imagery was localized very distinctly in my knees and calves; then this motor imagery expanded to include shoulders, back and arms, as I seemed to be swaying my body in an effort to keep my balance. This series of motor images was continuous both kinaesthetically and visually; I could attend momentarily to the kinaesthetic qualities of motion but the instant my kinaesthetic attention began to shift from one motor image to the next, the preceding image, then 'tapering off' in attention, had turned into a visual image of a black area localized where the motor imagery had been localized and formed into a moving streak or ribbon, representing the extent and direction of the motor imagery itself. If I tried to hold this disappearing motor image in consciousness I inevitably found that it had vanished and that I was attending to a visual synaesthetic image of the movement instead." [From this introspection it would seem that kinaesthetic imagery shifts to visual less suddenly than does imagery in *A's* other non-visual modalities. It is interesting to note that kinaesthetic imagery may tend to occupy focal attention so long as *A* makes no voluntary effort to hold it there, and that the kinaesthetic process may not become visual until it has nearly run its course in consciousness. It does become visual, however, before it entirely fades from non-focal consciousness.]

ii. Summary of introspective data on processes of imagination.

Observer A. A's imaginative processes are dominantly visual and this visual imagery is of two sorts: (1) visualizations of objects, scenes, etc., and (2) synaesthetic imagery which appears either with or without the primary imagery whose qualities and behavior it "takes over." Kinaesthetic imagery appears next in order of frequency, followed by tactual and then auditory. All of these non-visual "images" tend to shift at once into their visual accompaniments, the kinaesthetic type being delayed in this shift,

at times, with the result that it seems to occupy consciousness momentarily, almost by itself. Auditory imagery is practically confined to the auditory accompaniments of verbal imagery, and here the motor factor is much stronger than the auditory; both tend at once to change into visual associates. Of interest is the rareness with which tactual imagery appears in *A's* imaginative processes, and its confinement largely to tactual-kinaesthetic-visual complexes.

We find, as in our previous series of experiments, that *A's* visual images are relatively much richer in details of hue and brightness than in details of shape and outline. Accordingly, *A* pronounces his imagery rich in detail if in its general shape and form it is relatively persistent, or if his visual attention shifts, undisturbed, from one rather vaguely outlined object or region in his imagery to another. Indefiniteness of minute detail and indistinctness of outline may possibly be due to *A's* 17 years of blindness. In visualizing the traffic of a city street, *A* sees but passing shapes and forms for wagons, horses, automobiles and the like; in visualizing an office building, dots and patches of color represent objects on display in the show-windows; details of construction such as small bricks, large stone blocks and the like do not appear unless under a special *Aufgabe* to construct them voluntarily. The rank tropical vegetation of a jungle is represented by darkness, "thickness" or richness of the green color in the imagery and by glimpses of massed fern stems, clusters of "waxy" green fan-shaped palm leaves and the like. Details are otherwise lacking.

Structurally *A's* visual imagery may not differ from the same type of imagery in a poor visualizer, but functionally *A's* visual imagery is more important to him than is similar imagery in a sighted person who is asynaesthetic. The poor visualizer, as for example our other blind reagent, has a wealth of other imagery which compensates for a dearth of visual detail. Whenever and wherever visual imagery appears in *A's* consciousness, it occupies the focus of attention no matter how vague or imperfect that imagery may be. The poor visualizer's attention may be centered and usually is centered upon details of other types of imagery with the result that visual imagery itself seldom occupies the focus of attention.

A's introspections on his imaginative processes confirm our previous findings with respect to the functioning of synaesthetic processes; for not only do non-visual images always merge into the same stereotyped visual associates as appear in corresponding processes of perceiving, but these visual associates, now detached from their parent processes, symbolize original sensory experiences from the non-visual modalities. For example, feminine and masculine voices were represented by silvery, ribbon-shaped streaks of color and dark grey, splotchy clouds respectively. The chugging of an automobile motor, the tooting of horns, the roaring of an aeroplane motor were likewise represented by variously colored and shaped visual synaesthetic images. Tactual imagery of a cold wave dashing over the body, and difference in pressure against the balls of the feet in walking over rough ground were present in consciousness wholly in visual terms. In none of these instances were any non-visual qualities present to consciousness. The hue, brightness, shape, size, and behavior of the visual images represented the non-visual qualities and the behavior of the missing non-visual elements.

Observer B. Kinaesthetic imagery dominates in *B's* imaginative processes, followed by auditory and then tactual. Visual imagery is the least frequent and seems to appear more or less as a surprise to the reagent. The same features characterize these different types of images as were found in our previous experiments. Organic processes frequently accompany *B's* imaginations and are for the most part incipient innervations of muscular movement rather than imagery. In fact the reality and vividness of organic and kinaesthetic processes is throughout *B's* consciousness correlated directly with the extent of incipient motor responses.

iii. Observers A and B compared.

B is more imaginative in his everyday mental life than is *A* and consistent with this fact we find that *B's* imagery in processes of imagination are richer in detail, faster in appearance and disappearance and subject to longer and more complex groupings and successions.

As in previous experiments we find that *B's* attention is dominantly kinaesthetic while *A's* is dominantly visual. But again we find no parallel contents in *B's* mental life similar in function to *A's* synaesthetic phenomena. For example, if *B* has kinaesthetic imagery of a circle, this kinaesthetic imagery is not a symbol for a

visualized circle; one form of kinaesthetic imagery does not represent a white circle on a black background and another form of kinaesthetic imagery does not stand for a black circle on a white background. That is, there are no properties of this motor imagery which stand for former visual experiences. *A's* visual imagery represents specific qualities and modes of behavior of non-visual processes. Thus *B's* kinaesthetic backgrounds and *A's* visual backgrounds function in different fashions; the former supplement and indirectly render more definite such processes as appear in non-kinaesthetic modalities while the latter directly define and take the place of such processes as tend to appear in non-visual modalities.

Furthermore, while *B's* kinaesthetic images have possibly come to take the place of decayed visual functions, the former do not stand for or directly define the latter. *A's* visual synaesthetic images function more than in the capacity of visualizations of objects; they function further than as a mere substitution for decayed modalities.

iv. Significance of A's synaesthetic phenomena in processes of imagination.

Aside from confirming our previous findings with respect to *A's* synaesthetic phenomena, a study of his imaginative processes reveals added significant facts concerning the rôle which these phenomena play in consciousness. First, it is to be noted that organic and kinaesthetic imagery is slightly delayed, at times, compared with imagery from other non-visual modalities, in the process of shifting to its visual accompaniment. Although we had found some evidence of this in our earlier experiments the relatively greater frequency of organic and kinaesthetic factors in *A's* imaginative consciousness than in types of consciousness studied in our previous series has brought this difference into the foreground. This delay in the tendency for organic and kinaesthetic images to shift into visual processes means that they approach in their original form nearer to the focus of attention than do other non-visual images. As a result *A* is able to ascribe to them more definite attributes of their own. These facts suggest that a kinaesthetic process is so important, as such, in mental life, that no non-kinaesthetic process can function as an adequate symbol for it. It seems safe to conclude, therefore, that in *A's* case we find no exception to

the general rule that kinaesthetic processes are essential constituents of mental life. In *A's* case there are imaginative situations, particularly those which involve bodily movement or adjustment, bodily attitudes or motor attitudes as they are more often called, which are more or less implicitly capable of functioning in the development of meaning. At least they are sufficiently capable of so functioning that their transition into subsequent and definitizing visual processes is delayed.

We are inclined to regard this exception to *A's* synaesthetic functioning as not only one which was to be expected but one which throws added light upon the nature of synaesthesia itself and also upon the real value of consciousness. If we assume that the function of consciousness is that of evoking bodily movements—explicit behavior—we should expect that motor imagery itself, because of the fact that it is direct imagery *of movement,* should most readily of all imagery arouse movement and particularly that movement which the motor image anticipates. On the other hand one would expect that visual, auditory and tactual imagery might all lead to movement with approximately equal readiness. Thus, in *A's* case the visual concomitants of auditory and tactual processes would function quite as efficiently in controlling co-ordinated explicit behavior as might the auditory or tactual processes themselves. As a matter of fact we have seen that in his case the latter function in consciousness more readily than do the former. Hence it may be that his visual functions have a closer connection with bodily movement and hence function more readily in consciousness because they more readily lead to overt response than do the non-visual processes for which the visual images stand. We might assume by way of explaining this situation physiologically, that visual functions are more closely integrated with the motor projection areas of the brain than are his non-visual functions.

Furthermore, since kinaesthetic imagery is apparently more closely connected with efferent projection centers than any other type of imagery—witness the frequency with which kinaesthetic imagery is accompanied by or with which it leads to incipient innervations—even *A's* synaesthetic visual images do not always take the place of kinaesthetic qualities, in consciousness. All the more plausible becomes this view when we notice that kinaesthetic imagery is delayed in shifting to its visual accompaniment only when it is definitely followed by incipient movement.

D. Series 4. Free associations.

i. Typical introspective data.

[Instructions: I am going to present to you a word in auditory fashion to which I want you to respond orally with the first word which enters your mind. Ready. Now.]

58. *Observer B.* "While the experimenter was reading the instructions I was focally aware of his voice, together with increasing tendencies to sit more erect in my chair, to contract about the chest, shoulders, face and throat. There was also a slight tendency to hold my breath. The whole process thus far consisted of an attitude of alertness in which my attention was centered, in auditory fashion, upon the experimenter's voice. This latter fixation of attention consisted of tendencies to lean in the direction of the experimenter and to become conscious of faint sounds in the region of my right ear which was nearest the experimenter. Then I perceived the word 'whistle.' For an instant this dominated attention and the quality, enunciation and other details of the auditory perception stood out focally in consciousness, one following the other; just at this juncture I noticed a general tendency toward muscular contraction in the region of the abdomen and chest as if I were inhibiting my breathing, together with marked tensions in the back of my throat; these latter developed into incipient tendencies to assume a mouth and throat position as if to whistle and were accompanied by very faint and sketchy auditory-vocal-motor imagery of the word 'whistle.' Just as my attention was lingering upon these developing tensions I found myself beginning to innervate a word, the movements of which seemed to be derived from the positions of my lips previously taken in assuming a mouth position to blow. I then found myself saying 'blow' out loud. I was not aware of the word as such before I said it; neither was I conscious of any antecedent imagery which might have suggested it other than what I have described."

59. *Observer A.* Similar instructions. Word: whistle. Response: boy. "* * * As I heard the word 'whistle' I found my attention at once leaving the quality of the experimenter's voice and shifting to a visual image of a white, cloud-like form about the size and shape of a pillow case, with the visual quality a linen-white. This image was localized in space in front of me at a distance of about six feet. The right edge of this form—toward the experimenter—was much brighter than the rest and glowed as the reflected light from a white crystal might glow; (this I discovered was due to the 'sss' sound from the word 'whistle'.) This visual image persisted but at once began to drift upward and to the right. My attention was momentarily absorbed in wondering what caused this colored form; I then became conscious of the task in terms of a developing strained condition in my throat and in a tendency to repeat the word 'whistle' in terms of auditory-vocal-motor imagery of my own voice; but this latter imagery had but just begun to develop when my attention was claimed visually by an image of a boy with only head and shoulders showing and with no detail of eyes or other facial features. The general size and shape of the image indicated that it represented a boy rather than a man or woman. All during this time the synaesthetic image mentioned above was persisting non-focally in consciousness and was drifting off into the upper left hand field of vision. Upon the appearance of the boy in visual imagery I found myself tending to relax about the abdomen and shoulders as if the task were over, but the strain in my throat became greater and I found my attention shifting from my visual image to my throat region which was subsequently visualized in black. Then I first became aware of the fact that I was trying to say something and couldn't. After a period of brief delay I found myself saying, suddenly, 'boy' and along with this vocalization there appeared a dark grey, almost inky smudge in the center of my field of vision, entirely obliterating my visual image of the boy. This smudge was the stere-

otyped visual counterpart of the word 'boy' and is determined largely by the letter 'b'. (For a moment during the reaction I was satisfied that my visual image of a boy was my response to the stimulus word.)"

60. *Observer B.* Instructions the same as before. Word: become. Response: becoming. Reaction time, 3 and 3-5 seconds. "On hearing the word 'become' I had some auditory imagery which I have entirely forgotten owing, presumably, to the intensity of my efforts to find a stimulus word. Following this auditory imagery my attention was claimed by rapidly developing and long persisting tensions localized about my abdomen and chest, by undifferentiated organic reactions which I think involved respiratory and circulatory changes, all of which constituted a feeling of ghastness. This long and drawn-out motor reaction was followed by a spontaneous vocalization of the word 'gee!' Then I was aware of faint and syncopated auditory imagery of professor R. talking about 'becoming', but the word 'becoming' itself stood out no more clearly than did any of the other auditory imagery. Following this was a short period of utter blankness of mind so far as imagery was concerned, characterized by a lingering attention upon my motor tenseness. Then auditory imagery of the stimulus word appeared and persisted for some little time, then for only the briefest instant of time my attention shifted to auditory imagery of professor R's voice again and this was immediately followed by sudden vocalization of the word 'becoming'."

61. *Observer A.* Similar instructions. Word: become. Response: three. "As I heard the word 'become' I found my attention at once shifting from the sound of the word to a peculiarly shaped visual image like that of a letter 'B' lying on its belly. The left half of this image was dark grey; the right half was the color of bee's-wax. This whole image drifted off from my field of vision and I found my attention momentarily occupied with the entoptic phenomena which were left. I then reinstated the visual image just described and at this juncture I was first aware of the meaning of 'become'; up to this time I had not grasped the meaning of the word. I could not have told you what the stimulus word was until after this visual associate appeared the second time (having been 'yanked back' into consciousness by eye-movement); it seemed to me as if I were re-attending to the stimulus word itself, although there was no auditory or vocal-motor imagery present to consciousness. With no warning this visual image shifted its position, turning up upon one end, and the bee's wax turned into a deeper reddish-buff; my attention was automatically claimed by this new color; with no further intervening processes this color meant 'three' to me; I tended to have the word 'three' in vocal-motor imagery and together with this fleeting verbal image the color became more saturated and more definite in shape. I then found myself responding orally with the word 'three'." [This shows how in *A's* mental life one visual associate will suggest another, just as in ordinary consciousness one image suggests another. *A's* processes of association in this experiment took place entirely within the visual modality.]

62. *Observer A.* Similar instructions, with the added *Aufgabe* to watch for processes other than visual, if any. The stimulus word was 'genus'. Response: man. "While waiting for the stimulus word to be given my attention was fixed upon my throat and I was aware in tactual-kinaesthetic-visual terms of localized strains in my throat muscles. Upon hearing the stimulus word there appeared a bright area about like sunlight in the center of my field of vision; this image claimed focal attention to the exclusion of any consciousness of kinaesthetic or other processes. The white light came from the 'ge' sound in genus. I then became aware of the instructions and immediately found myself again visualizing my throat and trying to attend to the kinaesthetic and tactual processes from throat position and strain. Thereupon the whitish

light disappeared and with this disappearance of my visual image I found that I had lost consciousness of the stimulus word. By this time I became conscious of keeping the experimenter waiting too long for my response, consisting of tendencies to visualize the experimenter. As a result of this my awareness of my throat also tapered off suddenly into obscurity. My response 'man' came evidently as a direct association with my visual image of the experimenter, for immediately following this image of him I found myself vocalizing the word 'man'. With this vocalization there appeared the yellowish synaesthesia of the word 'man'."

63. *Observer B.* Instructions as before for observer *B.* Stimulus word: after. Response: before. "Following the perception of the experimenter's voice I was aware of very vivid and intense auditory imagery of the stimulus word, then of a schematic kinaesthetic image of my own throat and lips assuming a position to repeat the word. There followed a moment of hesitation in which my attention was centered upon the strained condition in my throat. Then, with no antecedent process or no warning, I found myself repeating in vocal-motor-auditory imagery the word 'before' and vocalized it at once."

64. *Observer A.* Instructions as before for observer *A.* Stimulus word: after. Response: brown. "There first appeared, together with my auditory perception of the stimulus word, a shapeless cloud of calf-brown color. My attention went at once focally to this color. At no time was I focally conscious of the auditory qualities of the word or of the experimenter's voice. For an instant I paused, during which time attention shifted, non-focally, to the region of my throat and I had the vocal-motor image: 'What is it?' referring to the calf-brown color which was aroused by the stimulus word. As if in answer to this question, I found my attention lingering upon this brown visual image and myself saying the word 'brown' in vocal-motor imagery. The brown was due to the 'ft' sound in the word 'after'. At no time during the experiment was I aware of the meaning of the full word. I was aware, however, that the brown meant 'ft' sound."

65. *Observer A.* Similar instructions. Word: nerve. Response: 'ous'. "Just as the word was perceived, a light yellow patch of color appeared, slightly pear-shaped but relatively longer at the small end than a pear. The left portion of the color-patch represented the 'ner' of 'nerve.' But the experimenter had no sooner finished saying the word when this color patch extended along the neck of the narrower portion and there became a much brighter yellow and I found that, at the same time, I was having auditory-vocal-motor imagery of 'ous'. The bright yellow is the synaesthetic associate for 'ous' sound. This brilliant yellow, together with the vocal-motor image of 'ous' persisted so long in focal attention that I found my vocal chords 'tied up'. I could think of nothing else. I therefore reported that I could not think of anything else and that my response was but a completion of 'nerve' into 'nervous'. (This is the fashion by which I always anticipate what a person is going to say next when I am listening to a lecturer or when I am taking part in a conversation. I anticipate the speaker's words in terms of color, with no clear consciousness of any vocal-motor imagery at all.)"

ii. Summary of introspective data on free association.

Observer A. The perception of the stimulus word invariably involves a stereotyped visual associate whose color or brightness is determined by the dominant sound of the stimulus word itself. This observer never focally "hears" the experimenter's voice nor is he focally conscious of auditory qualities in his own verbal imagery of the stimulus word. The latter imagery demands a similar

visual associate before it is complete. After the original visual associate appears in consciousness *A's* attention is directed to its behavior. If the image develops into no further processes either verbal or visual but begins to fade away or drift off to one corner of his visual field, trains of association are momentarily halted and *A* finds his attention claimed either by visual entoptic phenomena or by a strained condition in the throat. Under these conditions the throat strains may develop into an *Aufgabe* consciousness and hence to a recall of the stimulus word in vocal-motor terms. Thereupon the original visual synaesthetic image reappears. From here on in the course of free association the response develops invariably in terms of visual imagery. Perhaps the original synaesthetic image may change its shape or color; the product of such a change in the visual image represents a response word which the reagent immediately attempts to translate into verbal imagery. At times this translation process is delayed and as a result the reagent finds himself trying to pronounce a word which he cannot say. His attention is then claimed by visualized throat strains. The response is complete when the reagent has succeeded in translating the final color into its appropriate verbal image. It might be interpreted as being complete so far as the reagent's own consciousness is concerned when he has become aware of the meaning of this final color. Sometimes a verbal image identifies the color; sometimes an antecedent visual or verbal image has sufficed to give enough meaning to the final color to cause *A* to relax as if the response were complete; and sometimes the reaction terminates in a motor response which means familiarity so far as the reagent himself is concerned.

Peculiar response words result from the functioning of his synaesthetic images. "Three" was his response to "become," a totally irrelevant reaction from the point of view of an asynaesthetic person; but the "three" was suggested by the shape and color of the original synaesthetic image which accompanied the auditory perception of "become." The "be" sound of "become" has the same color as the "ee" sound in "three." Again, "brown" was his response to "after." This was determined by the calf-brown color which was aroused by the stimulus word.

Observer B. B's procedure in forming free associations is entirely different, as far as its content is concerned. He is first focally aware of the stimulus word; the quality of the experiment-

er's voice or the articulation of the word momentarily stands out with marked clearness. Then he has auditory-vocal-motor imagery of his own voice repeating the stimulus word or he is aware of auditory imagery of the experimenter's voice. Then there may occur a brief pause during which time *B's* attention shifts to kinaesthetic or tactual processes having to do with a strained throat condition or with more or less reflex incipient movements about the lips, tongue or throat. The response word may first appear in vocal-motor imagery, followed by innervation, or it may appear at once as an innervated vocalization. It is always suggested by some tactual or kinaesthetic antecedent process, such as a peculiar tendency to assume a mouth-position as if to blow, or such as a series of vocal-motor imagery having to do with memories of a lecture in philosophy. The mental processes in *B's* case are thus confined to kinaesthetic, auditory, tactual and perhaps organic sensations and images.

iii. Free association in A and B compared.

1. In the perception of the stimulus word *B's* attention is focused upon the auditory qualities of the spoken word. *A's* attention ignores the auditory qualities and shifts at once to a stereotyped visual concomitant.

2. In *B's* consciousness the auditory perception is followed by auditory or by vocal-motor imagery. In *A's* consciousness the visual associate of the auditory perception persists as a substitute for auditory or vocal-motor imagery.

3. *B's* attention is then directed implicitly toward the act of finding a response word; this act involves such processes as kinaesthetic sensations, verbal or auditory imagery or tactual imagery. *A's* attention is implicitly directed in similar fashion but the contents of consciousness remain dominantly visual and visually synaesthetic in their nature. While *B's* attention is shifting among kinaesthetic, auditory, and perhaps tactual processes, *A's* attention is shifting among changes in his visual synaesthetic imagery—from the original synaesthetic accompaniment of the auditory perception to a detached visual associate, representing an additional non-visual process.

4. The final cues for *B's* responses are kinaesthetic, tactual or auditory. *A's* response is a persistence of a visual image which

stands for an auditory, vocal-motor, or kinaesthetic process. At times vocal-motor imagery supplements the visual but the former is not attended-to focally.

5. Thus in free associations the functioning of mental processes is the same in both reagents, *i. e.*, both reagents are behaving in essentially the same fashion; but the mental contents differ radically in our two observers.

iv. The significance of synaesthetic phenomena in A's free associations.

A mass of introspective data on *A's* free associations brings out more clearly than in our previous series of experiments just how synaesthetic phenomena function in the development of meaning. We have seen that a stereotyped visual associate is involved in his perception of the stimulus word. If this visual image does not at once lead to further visual imagery or to some subsequent verbal process *A fails* to understand the meaning of the stimulus word. Such a subsequent process may consist of a tendency to vocalize the word in which case the original synaesthetic image is definitized, clarified, or modified so that it at once leads to a further process. *Meaning* is thus found in the *process-aspect* of experience and not in the content-aspect. For example, if in *A's* case a visual associate of the stimulus word fails to lead to some other visual image or to some other process, no meaning develops; but if the visual image leads or shifts to some other visual image or to some other subsequent process the experience has meaning. Mental contents are therefore only the tools, the mode or the method by which meaningful processes take place; the activity or process-aspect—the behavior of these contents—is the criterion of meaning. It is certain also that a combination or mosaic of contents must be in action before meaning can develop; such a group, of itself, does not provide meaning. For example, a complex visual synaesthetic image may appear in *A's* consciousness; such an image may virtually be a group of contents for the reason that in it are involved shape, various hues, size and what not. But if such a complex fails to *change* in some way, to shift, or to lead to something further in consciousness, the experience is meaningless. Detached mental contents are thus devoid of meaning. Ordinarily such colors mean something to our observer; they mean an object, a

word, a letter; they constitute an idea or what not. But they so constitute a meaningful experience only when they appear in a succession of flowing, *changing* mental contents. To illustrate: *A* once reported in the above experiments visual imagery of a small patch, dark steel grey on one side, shading into brilliant white on the other. This image partly disappeared, leaving behind it an isolated patch of white. Up to this time the synaesthetic image had meant the stimulus word "honest" for the reason that it had developed in succession with an auditory perception of the stimulus word and with a non-focal verbal image. But as long as this white patch lingered alone in consciousness without changing, *i. e.*, without leading to some further process, it continued to possess no meaning. On the other hand no visual synaesthetic image which happens to lead to some further process is devoid of meaning.

The reader has undoubtedly asked himself how it is possible that mere colors and brightnesses can mean so many things in *A's* mental life. If meaning consists of the behavior of mental contents, *A's* case is readily explained. In no sense modality are there so many different qualities as in the visual; in no sense modality can shifts from one quality to another, from one shape, form or size to another take place so rapidly or so easily as in the visual. Moreover, in no sense field is it possible to have as many different qualities simultaneously present to consciousness and thus simultaneously leading to further processes as in the field of vision. Thus we might expect that visual imagery may function most adequately of all the modalities as contents which provide meaning when they change or shift. The asynaesthetic person would find it either impossible or very difficult to cultivate his visual imagery to the extent that it will function as adequately as *A's* in this respect for the reason that such extended voluntary control of visual imagery as is possessed by *A* comes only with synaesthetic functions. *A* cannot help but employ visual imagery constantly in the development of meaning for the reason that this imagery is constantly present in his consciousness.

Our results on *A's* free associations also reveal added evidence that the functional significance of synaesthesis extends beyond the realm of perceiving. Here not only does the visual concomitant of the stimulus word "convey" the meaning of the word itself, thus leading to further associations, but verbal recalls of the stimu-

lus word usher back into consciousness this same visual concomitant; the success of the final response depends upon the behavior of this visual concomitant; subsequent verbal images of other words invariably possess their own visual associates; and finally, detached visual associates appear in response to or are suggested by antecedent synaesthetic images and they frequently appear minus their verbal counterparts; such detached visual associates which stand for response words function quite as well in the response itself as any verbal or kinaesthetic tendency in the asynaesthetic individual might function. For example, *A* at times finds himself relaxing, as if the response were over, when a final detached visual associate appears in consciousness as a substitute for a vocal-motor image. Subsequent throat tensions on *A's* part simply mean that he has not translated this detached visual associate into its corresponding verbal image for the experimenter's benefit. Further evidence that synaesthetic images are just as important in the realm of thinking as they are in the realm of perceiving might be given at length.

More striking than these facts, however, is the effect which these visual processes exert upon *A's* own interpretations of his experiencse immediately after they have taken place. Not infrequently, when *A* had recalled a detached visual associate of the stimulus word, did it seem to him that he were recalling auditory imagery of the experimenter's voice, although no auditory qualities as such were present to consciousness. So intimately bound up with sounds are colors in *A's* mental life that they are actually interpreted to be sounds. The same is true of pressure and other sensory experiences. But all of this may take place in the absence of peripheral stimulation. One can hardly ask for more definite evidence that synaesthetic phenomena should be regarded as true synaesthesis.

V. A Theory of Synaesthesia

The whole problem of synaesthesia needs working over in the light of more detailed and exhaustive laboratory experimentation. Too often has it been regarded an anomaly which aroused interest only from the point of view of curiosity. We have pointed

out that introspective descriptions of such phenomena have been lacking in the literature; that no investigator has demonstrated that synaesthesis is confined, in any one case, to the field of perception; and that only a very small percentage of contributions to the problem have mentioned the existence of extra-perceptual forms. Moreover, it is more or less remarkable that so few investigators have observed the apparent connection between synaesthesis and the general problem of meaning.

From a detailed study of only one case it will be impossible for us to derive conclusions which claim general validity. Neither will it be possible to confirm or destructively criticize much of the work which has already been done on synaesthesia. Our results have been obtained and have been interpreted solely from the point of view of the value or function of synaesthetic processes in the consciousness of our subject who possesses it. Nevertheless we feel justified in discussing certain alleged facts and certain theories which have appeared in the literature inasmuch as one case, thoroughly studied, ought certainly to prove suggestive.

As early as 1864 Chabalier (3) very nearly reached the core of the functional problem when he noted that letters were meaningless without their colored associates. One of the Nussbaumer cases of 1873 (8) throws some light upon the problem. It was noticed that isolated tones were always colored for the same individual, while musical concerts were not. This fact points to a cognitive theory of synaesthesis rather than to a physiological theory as such. For if synaesthesis is due to changes in blood supply in the brain—to the physiological disturbances underlying emotional states of mind—one would certainly expect that if colors were to appear in the one situation (isolated tones) and not in the other (listening to a concert) the concert would produce the colors. Any physiological view such as that of anastomosis of fibers or a lack of differentiation of function in adjacent brain areas would lead to an inevitable "seeing" of colors when tones were heard. If such theories were true one would hardly expect that in the same individual synaesthetic processes would appear one moment and not the next. But if synaesthesis is a cognitive process and purely functional in nature, rather than a phenomenon based upon structural-organic brain conditions, *i. e.*, if it is definitely a problem of

meaning, then we can understand how a person could experience colored tones without colored concerts. Combinations of tones, successions of tones and harmony possess different meanings from isolated tones. Thus while perceptions of isolated tones might, in a certain individual, require synaesthetic imagery, the understanding of a concert—an entirely different cognitive process—might not of necessity involve colored hearing. In a succession of tones a subsequent tone may interpret its antecedent while an isolated tone has no such subsequent tone upon which its meaning can be based.

In 1887 Steinbrügge (91) hinted at the evident nature of synaesthesis when he suggested that it was a "double-perception," or a primary perception accompanied by a "sub-perception." But he concluded that the visual synaesthetic image appeared too rapidly upon the sound stimulus to allow for the forming of an association between a sound and a visual image. Therefore he resorted to a purely physiological theory. In 1913 (2) Bleuler criticized the association theories of synaesthesis on the ground that colors may be connected with sounds in colored hearing as early in childhood as to precede the development of meaning. While no one knows exactly when meaning develops in the life of a child the assumption does not seem wild that imagery and meaning develop hand in hand. We know that synaesthesia has come to function as meaning in the mental life of our reagent; we know that it functioned as meaning as far back as he can remember. As long as synaesthesis persists we should expect it to function as a process of meaning; when synaesthesis disappears as it is said to do in certain cases, the particular meaning constituted by the synaesthetic process has likewise disappeared. Meanings are absolute whether they be specific or general. Meanings disappear with process-functions; new process-functions provide new but perhaps similar meanings.

The observed permanence of synaesthesis (see Holden, 4, Jordan, 5, and Wheeler, 11) points to permanence of meaning. For example a certain child might come to have a visual image of blue with the letter "e"; as long as this synaesthetic image persisted in the individual's mental life this same blue would always mean "e"; but if the blue should disappear in connection with the "e", some other processes would take the place of the visual synaesthetic

image such as auditory, vocal-motor or some other, and asynaesthetic visual image.

The stereotyped nature of the synaesthetic image offers no particular difficulty when interpreted as a meaning-phenomenon. Meanings are always stereotyped. This absolute nature of meaning provides validity to knowledge itself. But it is the manner of functioning of mental contents, rather than specific mental structures as such, which gives to meaning its absolute character. Thus if synaesthesis is a meaning-function we should here expect to find stereotyped meaning as well as structure and this is what we actually do find. The important issue, then, is not concerned with the fixed structure of the synaesthetic image but it is concerned with the manner in which one particular image rather than another happened to develop as the partner to the primary process in the growth of meaning. The problem in colored hearing is then: Why does a certain blue or yellow rather than an auditory or a vocal-motor image come to identify the sound of a tuning-fork; or why does the shift of attention from non-focal auditory qualities to a visualized color function as meaning rather than a shift from auditory qualities to other visual or to vocal-motor tendencies? In either case the shift of attention—the functional aspect—is the stereotyped factor and the problem lies in explaining why one subsequent process rather than another came to be selected as the identifier of the tuning-fork sound.

Hence our notion as to a plausible theory of synaesthesis has changed as a result of our present investigation. We do not argue that meaning is a cause of synaesthesis or that synaesthesis is a cause of meaning; nor will we admit that the two are accompaniments of one another for reasons which we will discuss later. We hold that synaesthesis *is* meaning; that it is a process of meaning. Thus we can no longer accept a theory of anastomosis or of entanglement of fibers for the reason, first, that such a brain condition would lead to a permanency of synaesthesis. Some forms of synaesthesis are not permanent. If fibers became entangled or anastomosed during growth we should expect them to always remain in that condition. Secondly, this view can hardly describe the situation with respect to synaesthetic phenomena in the higher intellectual processes where every other modality is paired with a visual image, and where association is reversible. Neither would

it explain how colored tones can exist without colored concerts. Thirdly, it presumes that synaesthesis is only a perceptual process, taking place with peripheral stimulation. And such, we have found, is not the case.

Furthermore we have been obliged to discard lack of differentiation of function as a possible theory. If brain areas are lacking in differentiation of function, thus causing a confusion between audition and vision, or causing a dual response from a single stimulus, we would have to conclude that in certain cases every localized sensory area *except* the visual lacked differentiation—a highly improbable state of affairs. Moreover, this view would lead every isolated tone and combination of tones to appear colored in colored hearing. This is not always the case. Again, since every attribute of a sound sensation or an auditory image, in our subject at least, has its concomitant in an attribute of the visual associate and determines this corresponding attribute in the visual associate, there must be as great a differentiation of function in the auditory as in the visual center of the brain, otherwise these detailed causal relations between the auditory and the visual processes could not exist. The auditory area, lacking differentiation, could not operate in causing differentiated functions in the visual area. And finally, neither of the two views just mentioned gives us any clue as to how a dissociated or detached visual synaesthetic image comes to stand for or mean an auditory process. In fact all of the physiological theories which have so far been advanced fail to take into consideration the cognitive functions of synaesthesis.

The facts which have been construed as pointing to a physiological theory are as follows: (1) the simultaneity of primary and secondary process in synaesthesis; (2) the close proximity of brain areas involved in synaesthesis; (3) the stimulating influence of drugs; (4) the irreversibility of (perceptual) synaesthesis; (5) the influence of fatigue; (6) the disappearance of synaesthesis during adolescence; (7) the dependence of secondary attributes upon primary attributes; (8) the early appearance of synaesthesis in childhood; (9) the suddenness and spontaneity with which any single instance of synaesthetic association arises. These arguments are either misleading, or, as we have already pointed out, their truth is open to very serious question. Rather than pointing to a physiological theory, these arguments all point to the cognitive nature

and functioning of synaesthesis and to theories of reflex mechanisms. They do not necessarily point to organic conditions.

Meaning involves simultaneous groupings of contents and process-functions. The brain areas involved in synaesthesis may be as far apart as brain anatomy will allow. Meanings are influenced, just as synaesthesis is influenced, by drugs. Meanings change during adolescence. Meanings are determined by attributes of sensory experience and so are synaesthetic images. Meanings obviously develop with the growth of imagery in childhood. Meanings develop "suddenly and spontaneously" in the same fashion as does synaesthesis. Who has not tried to comprehend the meaning of something and has not found that meaning "dawning" upon him suddenly and with evident spontaneity?

The "meaning"-interpretation of synaesthesis allows for perfect harmony between the facts which were alleged to have supported a physiological view and the facts which have been advanced in support of an association theory. (See 11, page 38, for arguments in favor of an association theory.) Otherwise we cannot harmonize the two sets of facts without positing two radically different species of synaesthesis, an assumption entirely unwarranted by the facts. If one reviews the facts concerning synaesthesis he finds everything in favor of the phenomenon as a meaning-function and nothing against it. Such facts in part are: the variability in localization of the secondary process; the intensifying effect of emotional experiences; the fact that no two people have the same association in synaesthesis except as a matter of coincidence; the fact that in some cases visual perceptions arouse synaesthetic visual imagery, and the like. In addition to these facts we are confronted by the following results from this investigation: (1) meaning is lacking in the absence of the synaesthetic image; (2) the synaesthetic image invariably identifies the primary process in every particular and in general as well; (3) wherever several primary processes have the same meaning they are identified by the same, single secondary process (for example, a flute tone is yellow, auditory imagery of that flute tone is yellow, the word "flute" suggests the same yellow, etc.); (4) the secondary process functions for familiarity; (5) the synaesthetic image may control the direction of the reagent's trend of thought; (6) the behavior of attention in perceiving and in recognizing is the same in our

synaesthetic reagent as it is in the check reagent wherever meaning develops; (7) the synaesthetic image functions in an *Aufgabe* consciousness as do other meaningful processes; (8) under conditions which do not allow for the development of meaning, synaesthetic images are meaningless; (9) synaesthetic phenomena function in the development of meaning as marginal or "background" processes of consciousness in the same fashion as does a kinaesthetic background in the asynaesthetic reagent; (10) synaesthesis is reversible wherever meaning is reversible and is irreversible where meaning is irreversible; (11) synaesthetic processes function in the foreshortening of meaning contexts.

We believe, therefore, that our past notion of synaesthesis must be changed. We must resort to explanations which will do justice to these facts as the most important features of the phenomenon in question. And to do this we must resort to functional reflex mechanisms rather than to organic brain conditions.

The first hint as to a possible reflex theory of synaesthesis may be found in the fact that synaesthesis is not an absolute simultaneous process as it is so often thought to be. Simultaneity comes about after both processes have appeared, in that they persist together, but in their behavior is to be found evidence that a stimulus-response function is operating. The primary process may function either as a stimulus or as a response, usually the former. The secondary process may have both functions under different conditions but usually the function of response, unless it is detached. In all instances the function of the given process depends upon the situation in which it takes place. In case of perceptual synaesthesis the primary process is usually the stimulus and the visual associate is the response. In imaginal synaesthesis the stimulus function of the visual image depends upon the mental activity which has preceded and upon the nature of the implied or explicit *Aufgabe* at the time. In all instances synaesthesis involves a shifting of attention (1) from primary to secondary process; (2) a momentary shift from secondary to primary and back to secondary again; or (3) repeated shifts from one half of the complex to the other, always ending with the visual associate. In no instance are both the secondary and the primary processes attended-to focally; the primary process always seems to be a "step behind" attention. In other words, everywhere in the synaesthesis of our subject we

found a stereotyped behavior of attention, namely, an inevitable tendency to shift away from primary process to secondary process, the only exceptions being a momentary shift in the reverse direction when the secondary process functioned as a stimulus. Such a stereotyped behavior of attention suggests that in essence the process is a reflex phenomenon. And because of the fact that the associated contents in synaesthesis do not appear associated in like fashion in asynaesthetic individuals we have called this reflex phenomenon a form of conditioned reflex. The inevitable shift or determination of attention toward visual qualities and away from non-visual qualities suggests that a mechanism of irradiation is at bottom responsible. Once a visual synaesthetic image has become detached from its parent process we have the phenomenon of disintegration or dissociation. When this dissociated image appears alone in consciousness but is clarified or rendered more stable by the advent of the primary process we have the phenomenon of facilitation. Stimulus and response functions are interchangeable. A certain muscular contraction in walking for example is at once a response to an antecedent contraction and a stimulus for a subsequent contraction. The visual synaesthetic image may likewise function in either respect. We are unable, however, to offer any reason why a certain color rather than another originally came to be associated with a given tone or other non-visual experience. One would have to know the original circumstances in detail to make such a suggestion. Perhaps one might assume that any given association between sight and sound or sight and touch was due to local functional brain conditions such as differentials in potential energy in different neuron patterns or to synaptic resistance and the like.

We liken synaesthetic processes to conditioned reflexes in that the associations in the former are evidently conditioned. For example a particular shade of blue comes to function as a response to the sound of a tuning-fork rather than as a response to a normal stimulus. We presume such a normal stimulus to be the word "blue", an *Aufgabe* process to recall a visual image of blue or the name of some blue object. The conditioned feature of the reflex is its artificial or arbitrary nature. Like the conditioned salivary reflex it is based upon the reflex mechanism of irradiation, presumably; but in synaesthesis we have a widespread tendency toward

such irradiation. The visual center in our reagent might be more closely related functionally to the motor projection areas than in normal reagents. Hence any stimulus tending to produce a response leads toward the motor projection areas by way of the visual area.

If such a hypothesis is true it would mean that in observer *A* the physiological processes subserving conscious activities would be somewhat as follows: Assuming at the outset that motor projection areas are quite as important for consciousness as are the so-called "sensory" areas, nerve impulses in *A's* case are drained from the various sensory areas toward the motor projection areas through the visual area. The latter evidently possesses a closer functional relation with the motor projection areas than do the other sensory regions. While this view may apparently assume that brain regions account for sensory specificity, there seems to be no reason why such an implication is not safe. Thus a tone is "seen" and not "heard" as far as meaning is concerned because, in the arousal of a definitized conscious process the visual area functions as the region of integration rather than the auditory. But we must assume, however, that since the sound which is "seen" is of auditory origin, the auditory region is as differentiated in function as is the visual, and, prior to the arousal of the visual concomitants, functions to determine in detail the behavior of the visual contents. The fact that no auditory qualities are "heard" directly does not necessarily mean that the auditory area lacks differentiation. Rather it means that the lack of "hearing" as such is functional and not organic.

Thus with all other sensory modalities it may be that the visual region places its final "stamp" upon the content of the resulting conscious process.

This view is suggested further by the fact that kinaesthetic imagery followed by incipient movement does not necessarily involve a visual process until a very high degree of definiteness is attained. It is consistent with the logical necessity of regarding sensory and motor impulses as equally responsible for consciousness and with the view that consciousness is akin to "motor" adjustment or possibly an incipient stage of "motor" adjustment.

To call synaesthesis a conditioned reflex does not explain the phenomenon. It merely gives it a functional name, or label, which

perhaps leads us to an appropriate description of synaesthesis. It will not tell us how the color was substituted for the normal stimulus. We draw upon the notion of irradiation in attempting to solve the latter problem. We cling to the notion of the conditioned reflex *nature* of synaesthesis because it provides for its great variability from individual to individual and for its stereotyped features; and opens a way to envisage more clearly its meaning-function.

After all, as to just what content shall function in a meaning process is an arbitrary and artificial matter as far as the content itself is concerned. The content is only a means to an end in that it is the method or mode by which the function takes place. The contents are conditioned and have no inherent worth as peculiar or unique meaning carriers. For example, most any sort of process from a visual perception to a vocal-motor image may mean a consciousness of a task. The contents concerned in the development and functioning of meaning are conditioned as much as the flow of saliva in response to a tuning fork. As long as the dog's mouth watered in response to a tuning fork in Pavlov's experiments the "tuning-fork-saliva" situation meant "meat." We do not intend to argue in a circle and to imply that meaning is a conditioned reflex because a conditioned reflex is a certain form of arbitrary meaning. We are arguing that the two phenomena are functionally identical.

That meaning is a reflex phenomenon is substantiated on the ground that the former must be a *process.* One mental content must lead to another before meaning is present. This shift, this action, this stimulus-response function *is* meaning. Factors external to the contents determine or condition just what the contents shall be in any given instance. After meaning has once developed it is the inevitable shift from one content to another which is the meaning finally, rather than the contents themselves. We can see no danger in regarding meaning as a conditioned reflex!

It is interesting to note, in passing, that Lowie (6) has drawn a parallel between synaesthesis and peculiar associations which evolve especially among primitive races. For example the Dakota Indians associated "lozenge" with whirlwind; for certain plain's tribes black meant victory or joy; the Cherokees associated "white" with "south," "red" with "east," "black" with "west," and

"blue" with "north"; certain figures represented good fortune or prosperity. Primitive man had preferential estimates of certain numbers. Wells (10) sees a possible similarity of function between symbolism, including autistic thinking, and synaesthesis. These are noteworthy recognitions of the significance of synaesthesis as a process of meaning.

Mudge has recently made a brief study of the types and qualities of visual imagery which asynaesthetic subjects associate with musical productions (7). The author apparently assumes, and we believe correctly so, that there is no sharp dividing line between synaesthesia proper and tendencies to associate visual imagery with focalized auditory qualities. But, as our present investigation shows, the synaesthesia which Mudge characterizes as exaggerated differs from the tendency to associate visual imagery with focalized auditory qualities in that in the former the visual associates are necessary in perceiving in auditory fashion. We do not doubt, however, but that such visual associates as Mudge has described assist in the development of meaning, although the investigation does not mention the problem of meaning. It would be practical and more appropriate to confine the term synaesthesia to such acts of perceiving or of comprehending in which the primary process remains non-focal.

VI. Summary

1. Our blind synaesthetic reagent possesses an entoptic phenomenon which is apparently due to inherent retinal light. By means of this phenomenon his synaesthetic colors have apparently been kept "alive." His entoptic colors are clearly distinguishable from his synaesthetic colors. The former are sensations and the latter are images.

2. *A's* synaesthetic imagery differs from his asynaesthetic imagery as follows: (1) It can be held before consciousness indefinitely by resorting to repetitions of the non-visual process for which the synaesthetic imagery stands; (2) it functions independently of specific outline, shape or form for the reason that unlike the asynaesthetic imagery it is not a direct construction of a visual scene or object; (3) it does not function as does other visual imagery as a secondary or supplementary process in connection with

non-visual processes; (4) here attention is invariably centered upon color or brightness first and secondarily upon outline or form while in asynaesthetic imagery size, shape, contour, etc. may be equally important features; (5) synaesthetic imagery functions differently in the development of meaning in that unlike ordinary visual imagery it identifies experiences which in the asynaesthetic individual are non-visual.

3. *A's* visual imagery appears in an entoptic visual setting and on a diffuse and always non-focal kinaesthetic background. *B's* visual imagery invariably appears in a kinaesthetic setting, never in a visual setting. Both reagents agree that visual imagery is more stable when it appears in connection with imagery of other modalities or when accompanied by incipient movement. *B's* visual imagery resolves itself almost at once into tactual, auditory or kinaesthetic processes. It cannot be compared with *A's* in matters of stability, detail, and sequence.

4. Both reagents agree that it is easier to visualize objects which have been handled in tactual-kinaesthetic fashion.

5. In recalling visual imagery *A* uses visual as well as other cues. *B* uses cues which are derived wholly from non-visual modalities.

6. *A's* non-visual imaginal life consists first of an indescribable consciousness which, with the sole exception of kinaesthetic imagery, can become a datum of consciousness only through the medium of visual synaesthetic imagery. *A* knows of the presence of this type of consciousness by means of changes in the behavior of the synaesthetic image. In like fashion he ascribes to this vague consciousness its implied "attributes" of quality, intensity, and duration. Without using visual associates he is aware only that "something" was present. Further, unless accompanied by visual synaesthetic imagery, there seems to be no possibility of knowing that this parent process ever was present or is present. In other words no image other than visual, with the one exception of kinaesthesis, can stand alone in consciousness. The vague, imaginal parent process is always something from which *A* finds his attention shifting. It is always a "step behind" focal attention.

7. These facts, checked against data from *B*, show that synaesthetic imagery in *A's* case function as essential components in the development of meaning and that synaesthetic phenomena are

themselves the development of meaning; they are acts of cognizing. In *B's* case non-visual imagery rises into focal consciousness in the presence of a dominantly kinaesthetic background. As such images develop in his consciousness they are meanings. These meanings are stereotyped. In *A's* case this development of meaning is functionally the same but it involves the presence of a stereotyped visual process. In the two cases the mental contents differ but the functioning of such contents as are present is the same.

8. *A's* early memories are confined exclusively to visual imagery. Experiences originally derived from non-visual modalities are recalled in terms of detached synaesthetic associates. *A* possessed synaesthetic phenomena as far back as he can remember. Original affective experiences are recalled in terms of synaesthetic imagery. Checked against *B's* early memories, *A's* data show that synaesthetic imagery consists of meaningful processes which identify original experiences as auditory, tactual, kinaesthetic or emotional in their origin.

9. While considerable evidence points to the fact that *B's* early memories have undergone considerable change in their content from visual to auditory or to kinaesthetic factors, *A's* early memories have suffered practically no such distortion. Tests over four years of time bear out this fact. *B's* early memories show by contrast the functional significance of synaesthetic processes in *A's* early memories. Evidently the presence of synaesthetic imagery, which is itself stereotyped, has kept *A's* original memory contents free from the usual distortion and elaboration found in the process of forgetting. *B* has found it necessary to elaborate or to distort the original content of his early memories in order to retain meanings, since the original contents have become vague and attenuated through processes of dissociation. But in *A's* case evidences of dissociation are largely confined to the separation of synaesthetic images from their parent processes. Since these detached associates require no such distortion or elaboration as do the asynaesthetic processes of *B* we may look for meaning in the functioning of synaesthetic images themselves. Our introspective data show that this interpretation is justified.

10. *A's* recent memories are almost exclusively visual in their content. It turns out that immediately after any non-visual experience has occurred, its visual associate tends to become detached

from the parent process. The visual associate thereafter dominates in processes of recall. Checked against data from *B* we find that *A's* synaesthetic processes in recent memories function as meanings.

11. A comparison of our reagents' early and recent memories shows that forgetting in *B's* case results in a gradual dominance of kinaesthetic contents and in *A's* case in a sudden dominance of visual synaesthetic images. In the former's case elaboration and distortion provide for the retention of meaning and for its simplification. In the latter's case detached visual synaesthetic images themselves function as meanings, and, being in themselves stereotyped and simple, require no such distortion or elaboration in providing for the retention of meaning.

12. In *A's* processes of imagination in which motor attitudes or incipient bodily adjustments are aroused, kinaesthetic imagery is less quickly translated into visual synaesthetic images than under conditions in which incipient movement does not take place. For the time being kinaesthetic imagery seems to be identified by incipient movement. But if the reagent attempts to attend to these kinaesthetic complexes they at once give way to complexes of visual synaesthetic imagery. The immediate arousal of visual associates is apparently unnecessary when a given non-visual experience leads directly to overt motor adjustments as does the kinaesthetic image. But before this entire process can be "cognized" visual imagery must enter consciousness.

13. In *A's* free associations synaesthetic phenomena function as follows: (a) in the perceiving of the stimulus word; (b) in the persisting of the stimulus word in consciousness together with vocal-motor imagery of the word; (c) as antecedents of further visual imagery; (d) as the responses which are ultimately translated into vocal-motor imagery and innervations of the response word. Evidence of the cognitive functioning of synaesthetic phenomena is found (a) in the fact that a synaesthetic visual image functions in the place of a response word; (b) in the fact that a synaesthetic image aroused by the stimulus word means nothing if it does not lead to a verbal image or to further visual imagery; but that it stands for non-visual imagery if it leads to a response; (c) in the fact that the synaesthetic image must be revived if through faulty attention the reagent fails to perceive the stimulus word; (d) in the fact that the synaesthetic image invariably

plays a dominant rôle in the understanding of the stimulus word; (e) in the fact that synaesthetic imagery frequently determines the direction of the free association; (f) in the false interpretation which the presence of a synaesthetic visual image sometimes leads the reagent to make; (g) in the fact that in recalling the visual associate of the stimulus word during delayed reaction it may seem to the reagent that he is recalling auditory imagery of the word, although no auditory qualities are present to consciousness; (h) in the fact that synaesthetic imagery frequently formed the content of a task consciousness. *A's* procedure, checked against *B's*, reveals the fact that while in *A's* free associations synaesthetic images are present the functional aspects of his responses are identical with those of *B*.

VII. Conclusions

1. Synaesthetic phenomena in the realm of *A's* imaginal life are functionally identical with allied phenomena in his perceptual processes. Synaesthetic phenomena are processes of identifying auditory, tactual, or other non-visual "images." Visual synaesthetic imagery of color or of brightness constitute an invariable and integral component of such "images."

2. There exists in *A's* mental life a non-definitized, vague, non-focal set of experiences which become data of consciousness only through the medium of visual synaesthetic images. It is the "raw material" from which definitized images or meanings develop. It is indescribable and is always a step behind attention.

3. The so-called "secondary sensation" in *A's* synaesthesia is invariably a visual image.

4. The synaesthetic imagery which functions in imaginal synaesthesia is throughout identical with the synaesthetic imagery which functions in corresponding perceptual synaesthesis.

5. The behavior and the attributes of the visual image in *A's* synaesthetic phenomena reveal the presence or absence of the parent image. This also holds for perceptual synaesthesia.

6. The visual associate fails to identify the parent image in the absence of the latter or when the visual image fails to lead to further mental processes. This holds also for perceptual synaesthesia.

7. The visual associate persists as long as does the primary image and frequently longer. The visual associate may be prolonged or retained indefinitely in consciousness if the reagent succeeds in arousing the primary image. This situation also obtains in perceptual synaesthesia.

8. The intent to attend to the primary image results in a clarification of the visual associate rather than in a focalization of the parent process. When the reagent is instructed to ignore the visual associate both the parent process and the visual associate disappear and the reagent's attention is claimed only by visualized strains of attending. This is also true of perceptual synaesthesia.

9. The only differences which we have found between perceptual and imaginal forms of synaesthesis accrue to the differences by which the two forms are stimulated. In the former a visual image cannot arouse an auditory or tactual perception or lead to a fixation of attention upon an auditory or tactual sensory experience in the absence of peripheral stimulation. In the latter, a visual image may arouse its tactual or auditory parent process.

10. Synaesthesis in our reagent is not confined to the field of perception; it is a cognitive process *per se,* pervading his entire mental life as far as it has been studied; functionally it differs in no respect from any process of meaning. Synaesthesis is a process of meaning.

11. Synaesthesis is not a freak phenomenon the explanation of which is to be sought in a unique organic condition of the brain such as anastomosis or tangling of fibers, lack of differentiation of function, circulation of the blood and the like. It is a normal mental function whose contents alone differ from the contents of similar functions in the asynaesthetic individual. In our reagent, at least, synaesthesis is not a surplus process but an essential one.

12. The behavior of synaesthesis together with its function in mental life suggest that it is a form of conditioned reflex. The conditioned features of these reflexes are the mental contents which have become stereotyped.

13. The various arguments which have been advanced in the past in favor of physiological theories of synaesthesia point to the cognitive nature of the phenomenon rather than to its organic nature.

14. It is suggested that the development of a conscious activity requires discharges from the motor projection areas of the brain; that in the act of becoming conscious of anything, in *A's* case, the visual area drains from all other sensory regions the impulses there set up by stimulation. In this way impulses which subserve the development of mental activities all pass through the visual area on their way to the motor area. This gives to *A's* consciousness its dominantly visual character.

15. The view that synaesthesis is cognitive harmonizes the facts which support the antagonistic physiological and association theories.

16. We believe that in our synaesthetic reagent's non-visual experiences we have found processes of the type which we assume characterizes consciousness at birth and of the type which characterizes the consciousness of an individual who has matured but who has suffered total amnesia and has been obliged to begin mental life practically all over again. In other words synaesthesis gives us an opportunity for studying as directly as is possible consciousness in its "undeveloped" or "undifferentiated" state, the state of the abstract sensation. In our reagent it is quite evident that imaginal as well as sensory processes have a direct root in an indescribable and cognitively undifferentiated type of consciousness.

Note

As this monograph goes to press, research work is being done on four sighted, synaesthetic reagents. While none of these reagents are trained introspectors such data as have been gathered confirm the following results: (1) Synaesthesia occupies the same functional place in the higher thought processes as it does in perceiving; (2) synaesthesia is a phenomenon of meaning; (3) the reagent does not become aware of the primary process until attention is directed to the secondary process; (4) the secondary process—the image—is not an incidental association; it is a content essential to the reagent's acts of cognizing.

In none of these four reagents is the synaesthesia as wide-spread as in our synaesthetic blind reagent and where, in the former, mental contents are asynaesthetic, meaning functions and develops as it does in the asynaesthetic person.

It is worth mentioning in passing that throughout this series of investigations we have found no possible clue that the mental processes of the blind are in any way different from the mental processes of sighted persons. Differences are confined wholly to contents and not to functions. It is obviously an injustice to segregate the blind, during their periods of education, from normal social intercourse with sighted persons and sighted children.

We have included in this monograph more introspective data than was perhaps essential to demonstrate our statements in the text. This was done for the reason that our psychological literature is lacking in data on the mental life of the blind. It is hoped that from the introspections herein may be noted the detailed and intensely interesting facts concerning the behavior and characteristics of imaginal processes in the blind. The monograph has run to such length that the writers felt it unwise to attempt here a summary of these facts inasmuch as the purpose of the research was not to study the mental life of the blind but the phenomenon of synaesthesia. A detailed analysis of much of this imagery is to be found in the main body of the text. To those who are interested we extend a hearty welcome to use these introspections toward the fulfilling of such purposes as they desire.

VIII. Bibliography

1. Azoulay, Leon. Audition lumineuse des bruits. *C. r. des séances de biol.*, Vol. 81, 1918, 1081-1082.
2. Bleuler, E. Zur Theorie der Sekundärempfindungen. *Zsch. f. Psychol.*, Vol. 65, 1913, 1-39.
3. Chabalier, in *Journ. de med. de Lyon*, Vol. 8, 1864.
4. Holden, E. S. Color associations with numerals. *Science, N.S.*, Vol. 23, 1906, 270.
5. Jordon, David S. Colors of letters. *Science, N.S.*, Vol. 46, 1917, 311-312.
6. Lowie, R. H. Psychology and Sociology. *Amer. Journ. of Sociol.*, Vol. 21, 1915, 217-229.
7. Mudge, E. L. The common synaesthesia of music. *Journ. App. Psychol.*, Vol. 4, 1920, 342-345.
8. Nussbaumer, J. A. Über subjectiv Farbenempfindungen. Wien, 1873.
9. Steinbrügge, Über secondäre Sinnesempfindungen. Wiesbaden, 1887.
10. Wells, F. L. Symbolism and synaesthesia. *Amer. Journ. of Insan.*, Vol. 75, 1918, 481-488.
11. Wheeler, R. H. The synaesthesia of a blind subject. *Uni. of Oregon Publ.*, Vol. 1, No. 5, 1920, 61 pp.
12. Wheeler, R. H. Visual phenomena in the dreams of a blind subject. *Psychol. Rev.*, Vol. 27, 1920, 315-322.
13. Wheeler, R. H. and Cutsforth, T. D. The number forms of a blind subject. *Amer. Journ. of Psychol.*, Vol. 32, 1921, 21-25.

BF233 Wheeler, Raymond H. c. 2
W567 The synaesthesia of a blind
subject with comparative data.....

Date Due			

BF233 c. 2
W567
Wheeler, Raymond Holder
AUTHOR The syaesthesia of a blind
subject with comparative data
TITLE from an asynaesthetic
blind subject.

DATE DUE	BORROWER'S NAME